HOUSE OF LORDS SESSION 1992-93

SELECT COMMITTEE ON SCIENCE AND TECHNOLOGY

PRIORITIES FOR THE SCIENCE BASE

EVIDENCE RECEIVED UP TO 31st JULY 1993

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CALL FOR EVIDENCE

Sub-Committee I have begun an enquiry into how priorities are set, and implemented, for the UK Science Base. By "the Science Base" we mean all scientific, technological and engineering research and postgraduate training, however funded, conducted at, or in close conjunction with, universities (old and new) and Research Council institutes. The Chairman of the Sub-Committee is Lord Flowers; other members are listed below[1]. We aim to make a report to the House of Lords by the end of this year.

The Sub-Committee invite written submissions on the following questions:

1. What is public expenditure on the Science Base for?

2. What are the objectives and priorities of the various funding agencies within Government?—Research Councils, HEFCs, other departments. Are they related? Is an overview required, and do the existing structures (ABRC, ACOST, OST) provide it?

3. What are the relationships connecting Government funding of the Science Base, funding by industry and charities, and overseas funding (particularly from the EEC)? Various people are "paying the piper": are they calling different or incompatible tunes, and if so is this a bad thing?

4. What information and advice is needed by those who are setting priorities? How do they know what is going on in current low-priority fields? How do they track developments overseas?

5. How do charities and companies which fund research set and implement priorities? How is it done overseas? Are there lessons here for the Government?

Universities

6. What are the objectives and priorities of the HEFCs in funding university research through block grants, and who is setting them and on what basis?

7. How is each university's block grant distributed between departments, and on what basis?

8. What are the impacts on priority-setting of—
    (a) the abolition of the binary divide
    (b) the regionalisation of funding
    (c) the shift of emphasis from core funding to project funding involved in the transfer of £150 million pa from the HEFCs to the Research Councils
    (d) formula-funding, research rating and moves towards an R-T-X model?

Research Councils

9. The Research Councils have explicit missions. How are these translated into priorities, by whom and on what basis?

10. How are the competing priorities of the different Research Councils (and the Royal Society and the Royal Academy of Engineering) reconciled within the limits of the Science Budget?

11. Are the priorities of the Research Councils skewed by the boundaries between the Councils' remits, by the existence of Research Council institutes, by international obligations to support "big science", or by anything else?

12. How is the money transferred from the UFC to the Research Councils being spent?

It may be that not all these issues will be of concern to you, and that you will wish to concentrate on those areas in which you have experience.

The inquiry will *not* cover the following issues:

- The size of the Science Budget;
- Technology transfer;
- Academic careers and the structure of the PhD;
- Arguments for giving **particular** topics or activities higher or lower priority.

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[1] L. Butterworth, L. Chorley, L. Dainton, L. Dean of Beswick, B. Perry of Southwark, L. Porter of Luddenham, E. Selborne, L. Tombs, L. Whaddon.

NOTE TO WITNESSES IN INDUSTRY, CHARITIES AND GOVERNMENT DEPARTMENTS

The Committee are particularly interested to know:

(a) what you are putting into the science base, and
(b) what you are getting out of it, and whether this meets your expectations.

INSTRUCTIONS TO WITNESSES

Evidence should be submitted to the Clerk of Sub-Committee I (Priorities for the Science Base), Select Committee on Science and Technology, House of Lords, LONDON SW1A 0PW.

Evidence must be clearly typed or printed on one side of A4 paper and take the form of an original copy. Long submissions should include a summary. Evidence becomes the property of the Committee, and may be printed. You may publicise your evidence between submission and publication, but in doing so you must indicate that it was prepared for the Committee.

Persons who submit written evidence may be invited to give oral evidence. Oral evidence is usually given in public at Westminster, and transcripts are published.

You may follow the progress of the enquiry from the Weekly Agenda of House of Lords Select Committees. This is free, and may be ordered from Miss Sue Hunt, Committee Office, House of Lords, LONDON SW1A 0PW, telephone 071-219 5791.

Further information from the Clerk, Andrew Makower, House of Lords, LONDON SW1A 0PW, telephone 071-219 6798, Fax 071-219 6715.

24 February 1993

THE SELECT COMMITTEE ON SCIENCE AND TECHNOLOGY

(SUB-COMMITTEE I—PRIORITIES FOR THE SCIENCE BASE)

PREVIOUSLY PUBLISHED EVIDENCE

HOUSE OF LORDS SESSION 1992-93

MINUTES OF EVIDENCE

TAKEN BEFORE

THE SELECT COMMITTEE ON SCIENCE AND TECHNOLOGY

SUB-COMMITTEE I PRIORITIES FOR THE SCIENCE BASE

Wednesday 17 March 1993

ADVISORY BOARD FOR THE RESEARCH COUNCILS

Sir David Phillips, Dr A Ganguly, Sir Eric Ash
and Dr D Libby

Printed pursuant to the Order of The House of Lords *19th May 1992*

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HL Paper 82—i

MINUTES OF EVIDENCE

TAKEN BEFORE THE SELECT COMMITTEE ON SCIENCE AND TECHNOLOGY

WEDNESDAY 17 MARCH 1993

Present:

Butterworth, L.	Flowers, L. (Chairman)
Chorley, L.	Porter of Luddenham, L.
Dainton, L.	Selborne, E.
Dean of Beswick, L.	

Examination of witnesses

SIR DAVID PHILLIPS, KBE, FRS, Chairman, DR A GANGULY, Chief Scientist of Unilever, SIR ERIC ASH, Rector, Imperial College London, and DR DON LIBBY, Secretary, of the Advisory Board for the Research Councils, were called in and examined.

Chairman

1. May I thank you for joining us in this the first official meeting of the Committee in our enquiry into priorities for the science base. Sir David, I am sure you would like to say a few words in introduction of your colleagues and perhaps in introduction to the session after which there will be the usual questions and answers.

(*Sir David Phillips*) Thank you, my Lord Chairman. May I introduce Dr Ganguly, who is the chief scientist of Unilever, Sir Eric Ash, the rector of Imperial College, whom I am sure most of you know well, and Dr Don Libby, who is secretary of the Advisory Board for the Research Councils; and, sitting in the row behind me, I notice, slightly to my surprise, three members of the ABRC secretariat.

2. They are not allowed to cheer, Sir David!

(*Sir David Phillips*) Going on beyond that, my Lord Chairman, I do not think I really want to say anything particular by way of introduction. I should rather respond to your questions.

3. Thank you. You very kindly sent us your advice to the Chancellor of the Duchy of Lancaster. I was rather struck by the fact that I did not find the word priority or priorities in it, but I did find prioritisation occurring once—I am not sure whether that counted—in a slightly obscure place. You talk about keeping under review the performance of the councils against their missions, but nowhere do you give the impression that you had anything to do with priority setting or quizzing the research councils about what their priorities should be in the light of that. I am sure that this is all implicit somewhere, Sir David, but I was surprised that you did not make it explicit.

(*Sir David Phillips*) I think that it is a fair point although I am not sure that our advice on the white paper on how government support for the science base ought to be organised was necessarily the place in which we should set out our views about priority setting. If you have also looked at the document "Allocation of the Science Budget 1993-96", which includes the three documents we have in the last 12 months or more submitted to the Chancellor of the Duchy of Lancaster, you will find a great deal about priority setting in it and an account of how we set about making sure that the research councils support all the activities that they regard as being most important within their base line budgets: the things that they bid for are therefore necessarily of lesser importance than the things in their base line budgets. That is an important discipline which forces prioritisation on the research councils and on the other funded bodies that we advise about, and it leads on to the ABRC itself looking at the priorities of the different research councils in comparison with one another and in comparison with their base line activities. Therefore, there is, as you say, implicit in the way the ABRC and the research councils operate a great deal of prioritisation.

4. Do you see it as part of the job of the ABRC to persuade the research councils that your sense of what their priorities should be are the priorities that they should adopt? In other words, do you just take their priorities and see how they get on with them or do you suggest what priorities they ought to have?

(*Sir David Phillips*) The first part of the answer to that, I think, is that the heads of the research councils are, of course, themselves active full members of the ABRC and they all play a full part in all the discussions—that is not how it was organised before 1990, but it is certainly how it applies now—so that they come to the ABRC with their list of priorities but also prepared to discuss their priorities both with the others heads of research councils and with the other independent members of the ABRC. Priority setting in my view becomes a rather complex interactive process that embraces the bottom up opinions of working scientists at the bench, influencing what happens in the research councils through their contact with or membership of the research council committees, and superimposed on that the opinions of people from outside the science base who serve on the research council committees and on the research councils themselves. The Medical Research Council, for example, has on the council itself two leaders of the chemical and pharmaceutical industry. They influence the views of that council and industrial members work similarly with other councils. When these priorities at the research council level come to the ABRC there is, as I have said, an interactive debate at that level. The independent members who are drawn, as my two colleagues here indicate, both from academia and from industry take part in that debate and it does lead, by a consensus view of the ABRC, sometimes to a rearrangement of research council priorities. That complicated interactive process seems to me hard to

[Chairman *contd.*]

escape and essentially correct. It includes bottom up processes and a degree of top down processes, but my colleagues, Dr Ganguly and Sir Eric Ash, may want to comment on that, my Lord Chairman.

5. It would be very helpful if they would address themselves to the extent to which priorities are proposed by the independent members for discussion by the research councils. Is there outside input, so to speak, from them?

(*Dr Ganguly*) It certainly comes up for discussion from time to time, my Lord Chairman. There is a logic in the top down and bottom up approaches which has a reasonable element of objectivity. What someone like me can bring to the debate are the priorities in wealth creation and how these relate to some of the subjects that have been proposed. After a series of exchanges we arrive at conclusions which have a logic that can be transmitted to others. I find such discussions very helpful and I should like to believe that an industrial point of view is welcomed by the research councils themselves. Really, my Lord Chairman, I cannot recall an occasion where there have been major disagreements as to what the prinities are; the approaches might be different.

6. What about Imperial College, Sir Eric?

(*Sir Eric Ash*) The independents are unlikely to come along and say, "Have you thought about doing research in subject X?" That is not the kind of input that would be useful. In fact, it is even difficult to do it at a lower level of aggregation. The kind of question that independents do ask—and I think particularly of a marathon meeting that we had just about ten days ago—is whether in fact a particular research council needs to address itself to all the problems that are being addressed and whether it would not be better to concentrate our resources on a smaller number of issues. That is the sort of question we should debate.

7. Prioritisation rather than priorities?

(*Sir Eric Ash*) Yes, my Lord Chairman.

8. There are many people who are funding the science base—the research councils, charities, government departments, industrial firms through contracts and otherwise—with much support from individuals and so on. Does that add up to a set of research priorities or does it just add up to a mish-mash? Are you trying to set priorities in an environment where it is really not possible to do so because of the activities of other people? In medical research the Medical Research Council accounts for approximately half only and one wonders to what extent their sense of priorities can prevail. It is not quite the same with the other research councils, I know.

(*Sir David Phillips*) I should want to go back to the account I have given of the essentially interactive nature of the process. The research councils and the Advisory Board for the Research Councils are very well aware of the support that is coming into the science base from industry, from other government departments and from the charities, and that forms a part of this interactive process and that gets taken account of. If I take it in the order of starting with the charities, for example, we have recently with the Medical Research Council and with the Agriculture and Food Research Council been much involved in discussions of the work on the human genome and on the genomes of other organisms. In parallel with that we are very well aware that the Wellcome Trust particularly also has an interest in that topic and it is through collaboration between the Medical Research Council and the Wellcome Trust that the United Kingdom has successfully bid for the establishment in this country of an out-station of the European Molecular Biology Laboratory to look after the informatics side of the process, the so-called European Bioinformatics Institute. That is an example of how the interplay between the charities and the Medical Research Council bubbles up into the processes of the ABRC. If you looked at the outcome of our second round of allocation advice this year, which is included in the collection of documents, you will see that support for genome work was at the top of our list of priorities for distribution of an unexpected £6.75 million; so the charities we are well aware of. Industrial support, as I have said, I believe that we are well aware of because at the research council board level and the research council level and at the ABRC level there are representatives of industry, particularly those industries that are concerned with the support of research in the science base, so we have over the whole system a rather good input from industry. As to other government departments the research councils to different degrees, following the Rothschild report of 1972, which some of you will remember well, include as members of the councils representatives of other government departments, so other government departments have a very strong input into the activities of the research councils. Since our reform of 1990 the chief scientists of other government departments no longer sit as members of the ABRC, but we do have a well established process whereby they receive the papers of the ABRC and if they wish to attend a meeting on a particular topic they are welcome to come. We have at least annually a meeting with all chief scientists of other government departments, and this was part of the meeting that Sir Eric Ash mentioned took place ten days or so ago. That included a long meeting with all chief scientists from other government departments. All of these other agencies therefore play a part in this complicated interactive process that I have been talking about, but again I should like to hear what my colleagues have to say.

(*Dr Ganguly*) My Lord Chairman, the only thing I can add is that one can never be absolutely certain that we have covered all areas. It is just not possible, particularly with industry support which can be very fragmented. The process of wide ranging consultation and exchange of information makes it as good as it can be without being absolutely certain.

9. I suppose that you could argue that there should not be a policy overall. I suppose that you have to have a policy to spend public money, but why should people who are spending private money fit in with any policy at all? Why should they not follow their whims? They have every right to.

(*Sir David Phillips*) I should be very suspicious of a too strong top down process in priority setting and I have great confidence in the interactive process that I

[Chairman *contd.*]

have been talking about coming out more often than not with the right sort of answer.

10. A strong voluntary element?

(*Sir David Phillips*) Yes.

(*Sir Eric Ash*) One of the reasons that I think one has to have a strategy is because I am quite sure that somebody would suggest that we ought to dispose of fewer resources if we did not, and I think that one needs to provide some kind of justification for resources.

11. For public spending?

(*Sir Eric Ash*) Yes, that is right. I should like to add that I think there is a powerful industrial input from the bottom up as well as from the top down. Individual researchers applying for grants from research councils are very often in contact with industry and, indeed, very often seek the support of industry for the proposals that they make to research councils. That is another route by which the industrial imperative plays a role.

Lord Dainton

12. My Lord Chairman, does that predispose a research council to make an award in that area or will it depend very much on circumstances?

(*Sir Eric Ash*) I think that it depends very much on the research council and even the committee within it, but broadly speaking I think that support from an industrial company, particularly if this is more than words, is regarded as a very positive indicator.

13. If I may ask another question, my Lord Chairman, has any analysis been done—and it may not be possible—to try to find out what fraction of your decisions in monetary terms are made, as it were, top down and bottom up and how much is reactive and how much is proactive? Is it definable?

(*Sir David Phillips*) It is difficult to arrive at. Within the overall science budget we do make some effort to distinguish within the allocation of research grants how many of them are purely reactive, and that is 19-odd per cent of the total budget, and how many are so-called proactive grants, grants in areas that for some reason have been identified as areas of particular importance. That amounts to 12 per cent of the total budget. If you add those together it means that 31 per cent of the total budget goes in research grants, but, of course, it gets to be more complicated when you think about it. As Sir Eric has said, the people making application for grants in a purely responsive mode will very often have been in consultation with the potential users of their research to see whether that is an area that is fruitful for further development so there is a sort of covert directed element there. On the directed side the ideas for areas in which there is a need for directed programmes often come from the bottom up rather than from the top down so it is not very clear cut, but as it stands, that is roughly what our position is.

14. May one ask what proportion of the total, because it is a vast area in between which is unspecified, has its own momentum, that is to say, ongoing programmes of a large scale, whether it happens to be particle physics or whatever?

(*Sir David Phillips*) My Lord Chairman, I think that it would be easy enough from the diagram that is provided in the advice to produce an overall picture of that. International subscriptions are roughly 10 per cent of the science budget, which is therefore some £100 million per annum. I should have gone on to say that, of course, the research council units and interdisciplinary research centres are often in areas that are considered to be of priority importance. Historically the Medical Research Council has had units, for example, in pneumoconiosis, which was to meet a profound social need, so that was directed research as well. If you add in unit and interdisciplinary research centre work on, say, superconductivity then you get to a rather larger total than 12 per cent of the budget.

Lord Dean of Beswick

15. Very recent reports on our performance in the international field do not paint a very good picture and they say that we are falling behind in technology on quite a broad base in comparison to our competitors. If the Government decides to do something about it and to make additional sums of money available, how would you deal with it? Would you be able to deal it totally independently, or could the Government lean on you by determining what the areas of urgency and priority were based on commercial viability? Finally, if you are deciding issues, are you moved at all towards the one that is the better bet for the future in commercial terms?

(*Sir David Phillips*) If I may take the last bit of that rather complicated question first, my Lord Chairman, yes, we are to some extent moved by what has potential in commercial terms. But the broader question really involves rather more than the support of the science base, that is to say, it is arguable that problems within industry are more concerned with identification of profitable markets, identification of good products, the financing of the production of those things, the design of products that consumers will approve and so on, than it is with the science base input to this process, so if one wanted to reform the state of United Kingdom industry it is at least arguable that one would not in fact start by worrying about the science base. Having said that, I think that it is interesting to look at the sectors of industry that people would regard as being successful in the United Kingdom. Now the winners would certainly include the pharmaceutical industry and still most of the chemical industry. As it happens these are the sectors of industry that historically, and up to the present, have had the closest and easiest relations with the science base. Broadly speaking they do not say: we want you to work in a prioritised way on this particular topic. What they tend to say is: we want you to produce the best possible people well trained in the modern subject so that we can deploy them in our business, so the science base is largely a people producing machine. We have here, my Lord Chairman, a representative of those industries.

16. As an engineer I was slanting my question to the restoration of the manufacturing base and although chemical has done very, very well there are huge areas where we have done badly. However, unless we start in my opinion to do something about

[Lord Dean of Beswick *contd.*]

it we may well even go out of existence in those fields. That is what was behind my question.

(*Sir David Phillips*) I think that Dr Ganguly would have something to say about that eventually, but let me say for my part that I think we have profound social problems in the respect accorded to manufacturing industry and the regard with which it is held, in the proportion of talented people who are attracted into it, in the way the whole enterprise is managed and so on. However, Dr Ganguly is closer to the work front that I am.

17. I personally philosophically will differ from you in my approach to education, but that is another thing.

(*Dr Ganguly*) Certainly the attitude in industry towards technology is undergoing a very rapid as well as a profound change. Part of the fact is that most successful industries rely on their ability to forecast market developments and then translate them into priorities for research and development that they wish to invest in. What they look for in the science base is for individuals who are capable of coming in to business, understanding what the emerging market demands might be and then exploiting the opportunities. This requires a change both in attitude of industry regarding emerging opportunities in this country and their ability to communicate the changes to academia. I do not think that we are doing that well enough as yet and there is a cause for concern there. However, it is really a wide problem which is restricted not only to industry or to academia but should be tackled jointly.

Lord Porter of Luddenham

18. Would you agree that so far in looking for criteria for priorities we have talked almost entirely about wealth creation and the application of science. Even when Sir David talks about the pharmaceutical industry he is accepting advice from industry that some basic research in organic chemistry is very valuable here. Would you agree that this is the easiest part of the problem in a way? One can have a logical discussion about whether one piece of research is more likely to improve wealth creation than another and that the really difficult one is on the science base which does not contribute to wealth creation. For example, particle physics was mentioned, and astronomy. The question I want to ask, my Lord Chairman, is this. What other criteria are there in cases like that? Wealth creation does not come into it. What are the criteria apart from wealth creation?

(*Sir David Phillips*) My Lord Chairman, I hope that I did not actually use the expression wealth creation and, if I did—

19. No, I think that it was Dr Ganguly.

(*Sir David Phillips*)—I used it in a sort of embracing sense. It is certainly the view of the ABRC that although wealth creation needs to be a major determining consideration there are other considerations, and one of those is certainly social benefit. For example, a good deal of the effort of the Medical Research Council and the Natural Environment Research Council and the Agriculture and Food Research Council is concerned with social benefit in the long term and, indeed, part of the influence of the pharmaceutical industry is to point to those areas of fundamental biology which in its view will lead eventually to therapies that they can deliver, and that is both wealth creation and social benefit.

20. Of course.

(*Sir David Phillips*) If I may just go on for a moment, my Lord Chairman, I should add too the consideration that there needs to be an element of cultural benefit. Although we are clearly, as we see ourselves and as others see us, poorer in international terms than we used to be we are still a relatively rich country, and in my view ought to be prepared to contribute our part to the advancement of human knowledge for its own sake. That applies particularly to particle physics and astronomy perhaps, but it does apply in some other areas of scientific research also, and we need not to forget it.

Earl of Selborne

21. May I go back to what is an organisational question, my Lord Chairman? Sir David advised us earlier that the chief scientific advisers from departments no longer attend the ABRC meetings, but we were told that there had been a successful meeting recently where all chief scientific advisers had attended with members of the ABRC and this helped develop strategic planning. Can Sir David elaborate on that further and tell us to what extent he sees the ABRC having a role presumably with the Office of Science and Technology developing a strategic planning framework for the publicly funded research base?

(*Sir David Phillips*) My Lord Chairman, I think that that gets me into somewhat difficult territory. It is certainly important that the ABRC should act in full awareness of other government departments' needs for basic and strategic research and their interests in applied research, but when it comes to the Government having an overall strategy for its research and development effort then we get into the territory of the chief scientific adviser and the Office of Science and Technology which I think is best kept separate from the activities of the ABRC.

22. Can you just elaborate further and say what your relationship is with the Office of Science and Technology?

(*Sir David Phillips*) We are an advisory committee within the Office of Science and Technology charged with advising the Chancellor of the Duchy of Lancaster on his responsibilities for civil science. Also within the Office of Science and Technology, indeed, the head of it professionally, is the chief scientific adviser, but his activity, as I said, in my view is best regarded as distinct from the activities of the ABRC. He attends the ABRC as an assessor.

23. Just to be quite clear about the purpose of this successful meeting where you reviewed the work of the departments and the work of the respective research councils, was that meeting in order to help the ABRC and research councils to determine their own priorities?

(*Sir David Phillips*) Yes, my Lord Chairman.

24. Or was it to help the departments determine their priorities as well?

[Earl of Selborne *contd.*]

(*Sir David Phillips*) Since the chief scientific adviser was also present I suspect that it served both purposes to some extent.

Lord Chorley

25. Priorities seem to me to have something to do with objectives and criteria, and some reference to criteria has been made. Do the heads of research councils when they are putting their case within the ABRC come to you with the same template of criteria and do they have to have the same template of criteria?

(*Sir David Phillips*) They have the same template of criteria, yes.

26. They have to?

(*Sir David Phillips*) Yes. I should remark, my Lord Chairman, especially to this Committee, that the ABRC first began to establish common criteria for the support of research within the science base in 1972, if I remember correctly, under the chairmanship of Lord Dainton, and the present criteria are very closely similar to those.

27. But if a research council were to have a different set of criteria it would not get very far?

(*Sir David Phillips*) No.

28. So in that sense it is very much top down: the agenda is created completely top down, saving Lord Dainton's presence?

(*Sir David Phillips*) In that sense the criteria partly, as we say, are internal criteria which have to do with excellence, timeliness and promise, which are fundamentally bottom up considerations; and the other half, the external criteria, are applicability, exploitabiity and general importance for the development of science which are essentially top down criteria. The councils and the ABRC need to apply all of these.

29. It occurs to one, all that having been said, and accepting all that, that a research council might have a quite different view as to the weight to be given to the external factors as opposed to the internal ones?

(*Sir David Phillips*) I think that that is entirely fair and I think it not improbable that a minister responsible for science would be prepared to say at some point: it is my view that these criteria should be given additional weight. Sir Eric may like to add something here.

(*Sir Eric Ash*) My Lord Chairman, I was just going to add that there are, of course, differences between research councils. I think that it would be almost impossible for the chairman of the Medical Research Council to come up with a programme that was purely cultural in concept, where there was really no thought and no expectation of some utility flowing eventually to medicine, whereas it is all too easy for the chairman of the Science and Engineering Research Council to do that in particle physics, so I think that there are major differences in emphasis.

Lord Dainton

30. But there is one very important common strand to all research councils, and that is the people who are the ideas on the hoof, as it were, and if they are not well trained then everybody is let down—basic science in the future, the applied science of which Dr Ganguly was speaking—so very high priority must rest on having high quality postgraduate training. I noticed that in your report last year a good deal of stress was placed on the desirability of proper training such as, for example, people going for a PhD going through an MSc course which was really seriously undertaking training, is that right?

(*Dr Ganguly*) Indeed, my Lord Chairman. That is a very important issue because it is a mix of a number of sources that creates a base for ideas that you mentioned. I think that it would be very dangerous to try to straitjacket it on the basis of certain preset criteria entirely, although we do need a sort of template of that. In my experience, my Lord Chairman, members of the research councils and other academic colleagues whom I have met there seem to have sufficient freedom to do exactly that. However, whether we do it sufficiently well or whether we are discriminating enough to challenge some of the less esoteric ideas I am not too certain. There is always a chance to filter, but certainly the freedom to think is quite plentiful.

31. My Lord Chairman, this touches on the relationships of the higher educational institutions or universities, as we must now call them, and the research councils. Do you feel that it is possible for your policies, for example, which concern that level of postgraduate research to get through to the universities, are they responding and is it more difficult in particular now that there are many more of them?

(*Sir David Phillips*) I think that that is an interesting point, my Lord Chairman. A fact that needs to be borne in mind here is that the research councils do not support the majority of postgraduate students.

32. Not now, no; they used to perhaps.

(*Sir David Phillips*) They used to perhaps in Lord Dainton's day, but they no longer do. Even at the PhD student level they support only something like one half of the total population. What one needs to look for if one is anxious, as we are, to improve standards and improve the appropriateness of postgraduate training is that the research councils need to influence the way in which universities approach the problem. Our manpower sub-committee at the ABRC chaired by Professor Howard Newby of the Economic and Social Research Council and the board have been rather active on this front. We issued relatively recently a discussion document on the nature of the PhD, for example, and we are trying to provoke debate both within academia and within the users of graduates and postgraduates on the sort of training that is really most appropriate; and it leads on, as you said, to ideas that we need better preliminary training before people embark on their research programmes and so on.

33. And more mobility between institutions?

(*Sir David Phillips*) Absolutely, my Lord Chairman.

Lord Butterworth

34. My Lord Chairman, may I follow through a little further this problem about the higher education institutes because I see that you have a recommendation that you suggest should not be immediately implemented because of the change in the dual support boundary that, if anything, there would be a further transfer of funds in respect of premises and academic staff costs from the funding councils to research councils. Let us take the academic staff costs first. How do you see this transfer taking place in practice?

(*Sir David Phillips*) You will notice, as you have remarked, that the ABRC actually shrank from making that a recommendation to the Chancellor of the Duchy of Lancaster in the white paper advice.

35. It made it into a recommendation to be carried out eventually.

(*Sir David Phillips*) Yes.

36. There are now things in the Finance Bill going in for two years ahead, so you have anticipated the Chancellor in this recommendation!

(*Sir David Phillips*) I should be surprised, may I say, my Lord Chairman, in my lack of knowledge of what will actually appear in the white paper, if it included a prospective section.

37. Have the ABRC thought it out about how the transfer would occur? Would this mean that academics were in part paid by the higher education institutes and if they had a research grant in part would be the employees of the research council? What is the machinery you are recommending?

(*Sir David Phillips*) My Lord Chairman, Lord Butterworth will know that precisely that system exists in the United States so there is nothing exceptional about it at all. It is just a question of the institutions being able to put together different funding streams in supporting their staff to do the jobs that the institutions want to have done.

38. So that an academic with a large grant in biology from the Science and Engineering Research Council would in part be the employee of the higher education institute and in part be the employee of the ABRC?

(*Sir David Phillips*) I should not go that far, my Lord Chairman. I do not see the necessity for that. This hypothetical academic would remain an academic employee of the university. The university would be using different funding streams to pay his salary according to what he did.

39. I will tell you why I am asking this. You say quite rightly at some point that the research environment in higher education institutes is crucial to the continuing health of the national science base, and so on.

(*Sir David Phillips*) Yes.

40. Then your detailed recommendations seem to be detaching further, dismantling further, the funding of the higher education institutions and it would become important about the prospective loyalty of one's staff whether they were looking primarily to the institution. Take this chap of mine whose research in biology is funded by the Science and Engineering Research Council; his next research, because he is a very able person in this field, is funded by the Medical Research Council. Would that bit of him be transferred then to the Medical Research Council? I could not see how this was going to operate in practice.

(*Sir David Phillips*) My Lord Chairman, I am afraid that I do not see Lord Butterworth's difficulty because he would remain an employee of the university.

41. Ah, he would, would he?

(*Sir David Phillips*) And the university would be handling these different funding streams, sometimes from the Science and Engineering Research Council, sometimes from the Medical Research Council.

42. If I may go on, my Lord Chairman, there is another recommendation about postgraduate education involving a training element and a research element. What you are suggesting—and again this is a Chancellor-like recommendation, "in future"—is that thought should be given to transferring funding from the funding councils to the research councils in respect of the research element of postgraduate students.

(*Sir David Phillips*) Yes, there is at present, I think, a good deal of lack of knowledge and understanding about the way in which graduate student work is funded. There are many people in academia who think it is supposed to be, for example, entirely covered by the research training support grant, which is actually a ridiculously small sum of money, of the order of £400 a year; and there are those who appreciate that the graduate student fees that are paid on behalf of graduate students should also contribute to the cost of graduate student training and there are others who understand that the block grant received from the Universities Funding Council at this stage should also be used in part for graduate student training. It is altogether a rather complicated picture which is very little understood on the ground. This was made perfectly clear by a working group study run by the manpower subcommittee of the ABRC which reported back to the board fairly recently and whose record I hope will shortly be published. However, it has already led to the establishment of a joint committee with the higher education funding councils, all three of them, together with representatives from the charities, the CVCP and so on, which will be looking urgently into this question of how graduate students are funded at the moment and going on from that how would the responsibility for seeing that they are properly funded be best apportioned between the responsible agencies. I think that it is an important question, my Lord Chairman.

Lord Butterworth] I have great sympathy, or at least sympathy, with the idea that we should be able to assess accurately the full cost of research, and I take it that this is part of that exercise, but that can be achieved by accountancy methods without, I should have thought, dismantling the authority of the higher education institutes.

Chairman

43. With respect, may I try to pull us back on course. We are supposed to be talking about priority setting.

(*Sir David Phillips*) May Sir Eric comment on that particular point, my Lord Chairman?

[Chairman *contd.*]

(*Sir Eric Ash*) My Lord Chairman, if I may go back to the question of payment of academic staff by research councils, the thing that would worry the higher education institutes about it is that it may be a rather unstable situation. One year you may have a lot of your staff happily funded by research councils and the next year you may have a lean year. It does work in the United States, my Lord Chairman, but I think that it is important to add that in the United States the typical system is that academics have a guaranteed salary from the university for nine months so that the uncertainty is confined, if you like, to a quarter of their total.

Lord Butterworth

44. What you are implying therefore is that a system of this kind were to be introduced it could well reduce the number of longer term staff in universities because the universities would have less money available to take a longer term view?

(*Sir Eric Ash*) No, my Lord Chairman, I do not think that it would have that effect. It would simply mean that you could optimally spread the research and teaching loads between different members of the academic staff. In the United States it is not unusual for people not to teach for a whole year because they have a major grant so they can, so to speak, buy their time for research from the univeristy. I think that it is a flexibility that the universities would greatly appreciate.

Chairman

45. We could spend several more hours discussing this very interesting matter, but it is not in fact the subject of our enquiry, with respect, which is of course priority setting. I must therefore bring it back to talking about the setting of priorities. In that connection, if I may go on from what we have been saying, may I ask what relationships you nowadays have with the funding councils in regard to things like the setting of priorities? The universities obviously do have to be brought along with you if you are to be effective in setting priorites for the work that they do. What sort of interplay is there between you and the funding councils in that regard therefore?

(*Sir David Phillips*) My Lord Chairman, that of course has become a more complicated problem over the past year in that there are now three funding councils, England, Scotland and Wales respectively, and a committee in Northern Ireland.

46. Four, in fact?

(*Sir David Phillips*) The ABRC has tried very hard to establish very good relations with these separate national funding bodies and I am now a full member of the Higher Education Funding Council for England, I am an observer in the Higher Education Funding Council for Wales. So far we do not have a relationship of that sort with the Scottish Higher Education Funding council but the ABRC held a meeting in Edinburgh a few months ago specifically in order to discuss these issues with the officials of the Scottish Higher Education Funding Council so we have been working hard at this interface and I believe that the situation is reasonably healthy as is shown by the fact, as I was saying in my answer to Lord Butterworth, that we recently, without any hassle at all, set up a joint working party on this issue of graduate student funding. I think that in future you will see more joint efforts of that kind and that indeed we do have to do that. To go beyond that I should say that 70 per cent of the funding upon which the ABRC gives advice is directly or indirectly in support of university research, and that adds up to a total of £700 million a year, which is much the largest single contribution to university research of any funding agency. The influence of the research councils on what goes on universities is therefore really quite high, and I hope that that is healthy. Maybe Sir Eric would like to comment on that.

(*Sir Eric Ash*) I do not think that I have anything to add to that, my Lord Chairman.

Lord Porter of Luddenham

47. My Lord Chairman, I should like to turn to paragraphs 21 and 22 and the matter of who gives advice on priorites for the science base. I take it that you are recommending the continuation of ABRC as an advisory body. You do not mention ACOST, which has been a rather similar advisory body. You recommend the setting up of a science and technology advisory committee, which sounds awfully like ACOST to me from what you say about it. The science and technology co-ordinating committee which you mention I take it is just an extension of the existing official committee, so that is understood. However, I should like to ask you about the future that you see and the relative position that they are going to have in giving advice of ABRC, ACOST and what presumably will be the STAC.

(*Sir David Phillips*) Again, my Lord Chairman, you are trespasssing on to territory which I am not really very well qualified to talk about which is under active discussion within the Office of Science and Technology and no doubt with other government departments on the recommendations that will appear in the forthcoming white paper.

48. But you are making a recommendation to the Chancellor of the Duchy of Lancaster?

(*Sir David Phillips*) Our advice in effect was that come what may the Office of Science and Technology will need to have within it an organisation that continues the process developed by the ABRC under its successive chairmen. That is the ABRC role and it goes back to what I was saying about the research councils' priorities, how different research councils' priorities are judged against one another and so on. That is the science base side of the activity.

Chairman

49. If I may perhaps put Lord Porter's question in terms where I think that you are competent to answer it, Sir David, and are not embarrassed by it either perhaps, there are various levels of priority setting in Government and you are one of them. A research council is another one and an individual university department is several steps down on that. ACOST or somebody like that is the highest level in Government- I suppose that Cabinet is the highest possible level—but where do you see this whole system from Cabinet to whatever body it is, ACOST

[Chairman *contd.*]

or otherwise, that advises Cabinet, ABRC and bodies concerned more with industrial activity, coming together and forming some sort of coherent picture of the priorities for the science base? It is not clear to us at this stage whether there is a thing you call priorities for the science base in a coherent sense.

(*Sir David Phillips*) My Lord Chairman, I have already said, or I have tried to say, I think, that I am somewhat mistrustful of any attempt top down to establish national priorities although it is not that difficult to identify in broad terms what they would be and it is not that difficult to see that they would be rather similar to the priorities that are agreed in other countries. Most countries at this point would say, yes, we think that it is important that we should be deeply involved in biotechnology, materials science, information technology and maybe one or two other things, but there is a common international list that we are all aware of and that is interesting but in my view not particularly helpful.

Lord Dainton

50. And indiscriminate in the sense that there are no priorities to it except that you could do this more if you had more money to a certain extent?

(*Dr Ganguly*) My Lord Chairman, it is a very important but a very difficult question. The balance between academic choice and freedom and the finite nature of resources is an unending debate. I cannot think of any country or institution where they have really sorted this out to any degree of satisfaction. Can it be improved? Is there a way that we think is better than another? I do not know the answer, I am afraid.

Lord Porter of Luddenham

51. My Lord Chairman, before we leave this, may I ask Sir David a blunt question on this. Would he be in favour of the demise of ACOST? He has been a member of it and he knows it. Would he be in favour of its demise and its replacement by the STAC, and what would be the difference?

(*Sir David Phillips*) My Lord Chairman, the blunt answer to that, I think, is that I should be in favour of the demise of ACOST and that would be on the general view formed over the years that a committee that attempts to be expert over the whole range of government activities is inevitably made up of a number of individuals with expertise in particular branches, some of those opinions will be idiosyncratic, but they will necessarily dominate the committee's view of that particular issue. I should rather have a general committee that looked down at the whole system, rather perhaps I should say as your Lordships do, and that perhaps covers the problem and identifies areas where the country may be missing out or gaps that ought to be filled or discontinuities in the system backed up, as necessary, by ad hoc committees of specialists in particular areas who could really look then at what ought to be done, say, nationally about materials science or whatever.

52. As Sir David knows, ACOST does have such committees, in fact, a number of committees in special areas. My Lord Chairman, I am finding it very difficult to see why this is any difference at all. Would it have a different sort of basic composition of membership?

(*Sir David Phillips*) Our proposal—and I insist that it is merely our proposal rather than anything that I know is likely to happen, my Lord Chairman—was that we need a committee of six or seven members rather similar to the American President's scientific advisory committee, which is very likely now to be disbanded, I understand, but which would have this top down overall responsibility for seeing what was going on and identifying that, I repeat, rather as your Lordships do. If I may go on from that, I think that we need committees, and again there is an American model. Professor Bromley in his days as chief scientific adviser to the American President instituted a system of so-called FCCSET committees, which is a peculiar abbreviation for federal co-ordinating committee on science, engineering and technology, or something like that. Anyway, that is not a standard committee but a number of specialist committees in particular areas. I am very much in favour of that as a mechanism and, indeed, there has been operating recently within the Office of Science and Technology a committee on genome research which has involved representatives of industry, the medical charities, the Medical Research Council, the ABRC and so on, experts in that area. I think that that is a very fruitful way forward.

Lord Dainton

53. My Lord Chairman, I wonder whether I might ask a question that relates to the enlarged university system and its relationship with the research council system. The total amount of money that is available of course to research councils has not gone up with the number of institutions that have been named universities. This must mean for the research councils that they will have to take decisions that will profoundly affect the development of the new universities—I mean by that the old polytechnics. It therefore means that the research council system really will have a very powerful shaping influence on the development of those. Is this a matter that you have discussed in the ABRC or the research councils and, if so, has it been interdigitated with the three funding councils' thoughts on this subject? Do you have views that there one ought to go back quite clearly to the old RTX system that was proposed some years ago by the ABRC? What is going to happen? I think that many universities are deeply concerned about this situation, new and old.

(*Sir David Phillips*) My Lord Chairman, I do not think I can claim that the ABRC has had an explicit discussion of this issue, but my colleagues, I hope, will comment in a minute or two on their views. My perception is that the ABRC and the research councils agree with the Secretary of State's instructions to the new universities that they should not forget their original missions; and their original missions did not entail the same degree of involvement in publicly funded basic and strategic research as has existed in the old universities. I think that that is very important and I think that it would be a great misfortune to the country if the ex-polytechnics gave in to mission drift and aspired to be similar institutions in all respects to the old

[Lord Dainton *contd.*]

universities. They already have an honourable mission which is highly respected in other countries. I remind you of the polytechnic institutes in Germany, Switzerland and France. I hope they will see that their mission is one which they ought to fulfil with pride. That having been said, the amount of research council support that the ex-polytechnics have been getting is in the same proportion to the applications coming from the polytechnics as the support going to the old universities, that is to say, they have not been applying for a great deal of support and the consequence is that they have received only a modest proportion of research council spend. If I turn for a moment to the block grant funding and the research element of that, my Lord Chairman, as a result of the research assessment exercise, which incidentally was another example of collaboration between the old funding council and the research councils because a research council officer was seconded from the Science and Engineering Research Council to the Universities Funding Council to act full time in working through the research assessment exercise, the ex-polytechnics now get about 7 per cent of the R funding for universities, which is an increase over what they used to get but it is still not in the normal proportion of the R funding. I hope that even those ex-polytechnics that receive relatively generous block grants now as a part of the 7 per cent will continue to adhere in principle to their original position.

(*Sir Eric Ash*) My Lord Chairman, there has been no real change in the research funding of what were polytechnics and what are now universities, and they have always been treated on the same level as universities, and the research councils have been careful to make sure that the committee had representatives of the polytechnics on it to make sure that there was fair play. The change is in the block grant fund. As far as mission drift is concerned, my Lord Chairman, I think that the real damage was done perhaps 15 years ago or whenever it was that polytechnics were first encouraged to start PhD programmes. I think that it is impossible to recover that situation now. There will be some mission drift and it is up to research councils to make sure that whatever drift there is, taking some of the new universities upwards, and perhaps taking some of the old universities downwards, the main funding should continue to be concentrated on the relatively small number of universities that can make best use of the resources.

54. You see, the economic forces driving in that direction will be very powerful simply because the amount of money that goes under the DR heading is now very significant and as the resource for the teaching element goes down increasingly universities of all kinds will be looking to improve their research record and research funding, and that seems to be a force that in a sense is out of your control now, is it not?

(*Sir David Phillips*) My Lord Chairman, I think that in fact a number of old universities perceiving the way in which funding was going have actually adjusted their portfolios between research and teaching quite cleverly to maximise their chances in recent years.

55. The old ones have.

(*Sir David Phillips*) Yes, the old ones have.

56. And the new ones will to follow them, will they not, just because it means more lolly?

(*Sir David Phillips*) But it does not necessarily mean more lolly unless you can get up into the higher levels in the research assessment exercise.

Chairman

57. I hate having to drag things back all the time, but we really ought to be talking about setting priorities.

(*Sir David Phillips*) Your colleagues, my Lord Chairman, have a wide range of interests!

58. They do indeed, and long may that continue! However, for this afternoon, let us come back to the main topic. Perhaps it is reasonable to ask you now three years after the event—your constitution as it were changed in 1991—whether there has been any impact of that change in the way that you are able to deal with priority setting and suchlike issues? Are you in fact in a stronger position?

(*Sir David Phillips*) I should say, my Lord Chairman, that undoubtedly there has been a great improvement, and it goes back to what I was saying earlier about the way in which heads of research councils are now full members of the ABRC and play a full part in all the debates including debates of one another's programmes and facilitate therefore the interactive process about which I was talking. The reform in the procedures followed by the ABRC has been very important in bringing about that sort of change.

59. I am sure that that is a very useful thing when there is a discussion in front of other people and the research councils thrash it out among themselves, so to speak, but that could be put in much less polite terms, and often is, that is, that the ABRC has become merely a creature of the research councils?

(*Sir David Phillips*) My Lord Chairman, I think that I will answer very briefly and rely on my colleagues to reply to that. My view is that that is absolutely not the case. Dr Ganguly?

(*Dr Ganguly*) My Lord Chairman, I am not aware of the situation prior to the current change, but I certainly find the quality, nature and extent of debate very enriching. I think that the research councils bring to the table an enormous amount of homework. I should like to believe that we bring to the table a reasonable amount of our experience and expectations, and I find the resulting deliberations and exchanges very meaningful.

60. And how many independents?

(*Sir David Phillips*) Six, in addition to myself.

Lord Butterworth

61. I respect what you have just said, but there is a problem, is there not? The changes in 1991 were intended to make you more effective as a priority setter and you have explained to us, I thought convincingly, the changes that have occured, but does that not make the constitutions of the research councils look rather old fashioned, each independent under its own charter? Has not the time come when those charters ought to be abolished?

[Lord Butterworth *contd.*]

(*Sir David Phillips*) My Lord Chairman, may I go back to the statement part of that question to begin with and say that I do not recollect that in the papers leading up to the reconstitution of the ABRC the argument was advanced that this would make it a more effective body in priority setting. That is no doubt your Lordships' interest at the moment, but it was not the drive in 1990. The drive in 1990 was to make the ABRC a more effective body in bringing about collaborative working between the research councils, harmonisation of their activities in relation to the university system and so on, so priority setting was not at the top of our list at that point. If I may go on now to the question, my Lord Chairman, I do not think that the ABRC role does infringe the charter responsibilities of the research councils. At some point in debate within Government if the five chartered research councils come forward—as they necessarily will—with different sets of plans for activities over the coming financial period and funds to support these activities are not unlimited, choices will have to be made between these research councils. It is the business of the ABRC to advise the Government on what those choices should be. Now that does not impact on the charters of the research councils in my view. Somebody would have to make those choices whatever happened.

(*Sir Eric Ash*) Perhaps I may just comment on the effectiveness of the new versus the old ABRC. I am a survivor from the old and I have no doubt whatsoever that the new is vastly more effective. First of all, we have the heads of the research councils as full members, but equally important, it is a much smaller committee and it is more effective for that reason alone. I do not think that there is any danger of ABRC becoming in a sense the creature of the research councils. For one thing one must remember that the research councils are actually in a competitive stance for limited resources, so that it is hardly a situation where you have a monolithic block of research councils having it all their own way. I think that there is a genuine debate and I think that reasonable conclusions emerge from that debate.

Chairman

62. You have a certain flexibility margin, as I understand it?

(*Sir David Phillips*) From time to time we have had a flexibility margin, my Lord Chairman.

63. That perhaps is the answer to my question, which was going to be, how does it work?

(*Sir David Phillips*) We found it a very useful mechanism over a period of several years really—without looking at the papers I should say from about 1984 until last year. It was always subject to the risk that the Treasury would regard it as spare money that we were keeping in reserve to allocate later. In some senses that fear was perhaps realised last year when as a result of the autumn settlement we actually lost the flexibility margin. I know that was really concerned with the difficult economic circumstances of last autumn's financial settlement and ought not to be seen as the Treasury capturing a particularly vulnerable part of our funds. Nevertheless, it gave us to think about the flexibility margin.

64. It does not encourage you to think about sound financial management?

(*Sir David Phillips*) I should say that previously it had been a very useful mechanism. It allowed us, for example, at rather short notice to divert funds into the purchase of our first supercomputers in this country which have proved to be of enormous benefit to more than one research council. At this instant within our funds we do not have a flexibility margin. One of our reasons for being relatively content with that is that the research councils themselves have become much more aware of the need for flexibility within their own funds and we rely much more on them.

65. You advise ministers?

(*Sir David Phillips*) Yes.

66. Especially on the distribution of resources between the various research councils and the like. Is it fair to ask in what way ministers in practice can apply independent judgment?

(*Sir David Phillips*) Our advice covers both the total resources that we deem to be needed for the proper support of the science base and the way in which those resources ought to be allocated. It is fair to say that over the ten years or more that I have been the chairman of the ABRC the Government has only once accepted our advice on the total resources needed for the science budget, but as against that it has rarely failed to accept our advice on the distribution of the science budget: it has gone against our advice on the distribution of the science budget when there have been other matters that the Government or the minister responsible has regarded as of countervailing importance. The importance that the Government attaches, for example, to the British Antarctic Survey is such an example.

67. That was quite extraordinary.

(*Sir David Phillips*) Extraordinary in the technical sense, yes!

68. I see, so that although there is a problem in principle of there being some rival adviser somewhere, in practice this does not happen. One thing that worries me about the whole business of setting priorities, Sir David, is that there is a fashion in science, is there not, in that it is fashionable to be doing certain things and everybody says *those* are the things that you should be doing and *that* is old hat?

(*Sir David Phillips*) Yes.

69. And old hat very often turns out to be the next exciting thing. Do you encourage a conscious attempt by all concerned to try to see what unfashionable things might become fashionable? The trouble it seems to me is that all the advisers at all levels ultimately are the same people, are they not, and we are all affected by these ideas, unless we are quite extraordinary people, of what is regarded as important at the moment, and this runs across all countries?

(*Sir David Phillips*) I agree with that, my Lord Chairman.

70. What can one do about it, and do you do anything?

(*Sir David Phillips*) In the first place I should say that the ABRC's methodology, which is to insist that

[Chairman *contd.*]

councils support the activities of the highest priority within their base line budgets, is to some extent a counter to what would otherwise be a royal yacht syndrome. I think that there was a tendency in earlier years for councils to come forward with the latest, most exciting thing in science as the highest priority for new funds. Our methodology insists that if it is that exciting and important it ought to be paid for within the base line anyway. That leads on to what do they talk about within the base line, and it is certainly the case that we do at the ABRC and at the research councils discuss the importance of general areas of science which support the rest but which are not themselves at this instant remarkably fashionable. Your Lordships identified one such area in systematic biology recently, and that has been looked after in part by the NERC in the special programme which owes something certainly to your Lordships' activity, but it was also something that we were aware of within the science base and which the NERC was studying through the mechanism of a report from a sub-committee chaired by Professor John Krebs of Oxford University, so your Lordships and that consideration came together, I hope, in a successful outcome. We have been concerned recently with the health, say, of general chemistry and general physics in this country which I think fit into your picture of the necessary substratum of lowest priority activities which can easily become neglected, and we are very well aware of the need to look after these areas of science.

71. The taxonomy effort that we and, before us, you looked at is a bit of a lesson for all of us, is it not?

(*Sir David Phillips*) Yes, it is, my Lord Chairman.

72. World wide the subject had been put on one side whereas now it is seen to be absolutely vital?

(*Sir David Phillips*) Revolutionised also by modern science.

Lord Porter of Luddenham

73. I should like to hear Sir David's view as to whether it is really true that leading edge science is getting bigger or whether you are making it bigger by making it easier to get a grant or award in an established field. If one looks at what I should regard as some of the most original developments over the last few years they are leading edge for sure but they are not getting bigger if one mentions warm superconductors, the crystal structure of the photosynthetic reaction centre and Buckminster Fullerene. All these needed hardly any money at all. Buckminster Fullerene was more or less driven out of this country because they did not get the funding. This is leading edge science, and it is not getting bigger. Is this not a rather interesting question which suggests that it is the funding policies which make science get bigger?

(*Sir David Phillips*) My Lord Chairman, I think that the word bigger is your paraphrase of a rather more complicated argument in paragraph 43 of our report which suggests that science becomes more complicated and more expensive and more able to benefit from advances in technology. The middle example that you gave there, for instance, of the structure of the photosynthetic reaction centre actually depended upon the availability not only of synchrotron radiation but also of advanced supercomputers and modern molecular computer graphics to do the work. That was work that could not have been contemplated 20 years earlier. If we turn to your own field of research I am sure that when you go into the laboratory you are quite keen on having a femtosecond laser rather than a picosecond laser. Such developments affect the work that you do, but they do cost more, and it is exactly that sort of escalation in the technology that is available that is opening up new vistas in science and leading to a continuous escalation both of the opportunities that are available and the costs of meeting them.

Chairman

74. In other words, this is the point about whether the funding policies are encouraging the bigness of science?

(*Sir David Phillips*) My Lord Chairman, I do think that there is a problem that it is in effect an easy route to take advantage of, for example the fact that you can now get a 700 megahertz nuclear magnetic resonance spectrometer rather than, as it was only a few years ago, a 90 megahertz spectrometer. There are certainly new experiments which anyone can do at the higher frequencies that could not be done before, so there are some ways in which new technology makes thinking about new experiments easier than it ought to be.

Lord Chorley

75. Would not Galileo have said the same thing when the telescope was invented, that he had to have this new piece of equipment called a telescope, whereas he only used his eyes? Has anything really changed?

(*Sir David Phillips*) Well, my Lord Chairman, I do not know how expensive Dutch spectacle lenses were at that time.

76. In relation to other things, probably quite a lot!

(*Sir David Phillips*) I think that Dr Ganguly would like to come in here, my Lord Chairman.

(*Dr Ganguly*) My Lord Chairman, it is important because we ask this question in industry all the time. The expense of doing science is increasing all the time. We keep returning to the cost benefit analysis. The point of fact is that analytical techniques are getting finer, the ability to measure is getting better and more revealing. What possibly we do not challenge as much as we might is whether we are getting the maximum productivity, with more people sharing the facilities rather than duplicating. I think the computer study Sir Eric Ash led was very revealing in this regard.

(*Sir Eric Ash*) My Lord Chairman, I think that computers in a sense are the easiest thing to use 24 hours a day and seven days a week and the supercomputers that we have in this country are certainly used that way. What surprised us was that it turns out that work stations that one might have thought many people keep idle over the weekend are also worked extremely hard, so I think the problem is fairly easy in the case of computers. The NMR machine is a different matter. In my own experience

[Lord Chorley *contd.*]

we have an NMR machine in various hospital medical schools which is used on patients in the day time and for research at night.

Chairman

77. Twenty years ago we used to talk about the sophistication factor but I do not see this phrase round much now. Why is that?

(*Sir David Phillips*) Classical scholars would have some problems with the use of the word sophistication, I think.

78. Apart from that—?

(*Sir David Phillips*) It is the same phenomenon, yes.

79. I mean, there was always a problem persuading the Treasury that there was such a thing. Is that really the reason?

(*Sir David Phillips*) Part of the reason for that, of course, is that it is hard to think of a government department that would not advance the same argument to the Treasury for an increase in its budget. Defence or health or any government department would say, more things are now possible and we need new money to do them.

Lord Dean of Beswick

80. Are you ever influenced in your priorities by what our competitors abroad are doing?

(*Sir David Phillips*) The short answer to that is, yes, my Lord Chairman. Science certainly at the leading edge is a very international activity and any scientist worth his salt is very much aware of what his international competitors are doing in other countries.

Chairman

81. Does the ABRC consciously track what is happening overseas systematically?

(*Sir David Phillips*) We do not have a specific mechanism for following what goes on overseas, but thanks to modern technology both I and members of the secretariat keep abreast of the world literature by I think efficient methods, so, yes.

82. I suppose that the research councils do also?

(*Sir David Phillips*) Indeed.

83. Finally, may I get into the nitty gritty a little. We have not really talked about priorities of different modes of funding things. You gave a few proportions. Are there policies about "let us have more responsive mode funding and less directed funding" or vice versa? Do the ABRC necessarily agree with individual research council policies?

(*Sir David Phillips*) I have already tried to indicate, my Lord Chairman, that that is a complex matter that the ABRC tries to keep closely under review. It is a matter that the scientific population gets to be very concerned about if it thinks that there is too much drift away from purely responsive work into directed mode work, so we are very sensitive to that. On other modes of funding, one of the major concerns has been to what extent ought we to be supporting work in freestanding research institutes as compared with work in universities, and over the years the trend has been away from institute research towards more research in universities and, if not out of research institutes, into more work in institutes that are closely associated with universities. The transfer of the Institute of Oceanographic Science, for example, to the Southampton campus is an example of that process. Incidentally, it is an example of collaboration between the research council system and the funding council system. Then there is the other intermediate mechanism of research council units—and I use the word units drawn from the Medical Research Council experience—and our more recent invention of interdisciplinary research centres which are also a way of directing research into areas that are perceived to be of growing importance. Most of the interdisciplinary research centres are in fact on subjects that are perceived to be of high priority such as the warm superconductors that Lord Porter mentioned, but also polymer chemistry, which was perceived to have languished in this country and to need reviving, so they are a mixture of priorities drawn from new opportunities and a wish to supplement work that was at risk in this country. There are those centres as well therefore. Finally, there are facilities needed for carrying out science of all kinds. I have mentioned synchrotron radiation. There is the need for neutron sources. Going beyond that on to the international scale, of course, there is a need for access to the facilities provided by the European Space Agency and the facilities provided at CERN for high energy physics, so all of these are different modes of funding which are actually in support of university research but need to be considered carefully and the balance between them properly assessed.

Lord Porter of Luddenham

84. Apart from facilities which one understands are for everybody, is there not a case for institutes and universities bidding on a level playing field when they are doing the same sort of research?

(*Sir David Phillips*) That is increasingly the mode. The Natural Environment Research Council, for example, runs a good deal of its work currently through community research programmes within which university scientists and institute scientists compete for funds, and similarly in the Agriculture and Food Research Council.

85. But not, for example, the Rutherford Appleton laboratory which in some areas is competing directly with but not competing on a level basis with the universities?

(*Sir David Phillips*) The Science and Engineering Research Council would claim that the amount of research carried out on its own initiative at the Rutherford Appleton laboratory is no more than that needed to keep high level scientists abreast of their field and that the laboratory exists essentially for the support of university research.

86. I have heard that.

Chairman

87. From what you have just said, Sir David, it leaves unanswered one uneasiness that I certainly have, which is that it must be getting increasingly

[Chairman *contd.*]

difficult for a bright young researcher just starting off in his research to get properly launched except by hanging on to the shirt tails of an etablished group. If that is right, and I know that they are concerned about it in the United States, what can be done about it?

(*Sir David Phillips*) Sir Eric Ash wishes to speak, my Lord Chairman, and I do not wish to stop him, but let me say to begin with that from my own experience I see great advantages in young research workers being associated with a scientific patron. That having been said, there are of course schemes, and the Royal Society scheme of university research fellowships, which some of you are very much familiar with, is pre-eminent among them, for providing long term support for outstanding young scientists. My view is that that scheme probably needs to be enhanced.

(*Sir Eric Ash*) My Lord Chairman, perhaps I may just add that ABRC did have a working party on peer review under Professor Margaret Boden, and one of the things that we looked at particularly carefully was whether young researchers stepping into new academic posts were being disadvantaged. In fact we found no such evidence. We found that on the average they had much the same successes as their senior colleagues. We were surprised by this, my Lord Chairman, but perhaps it is because the research councils lean over backwards to help them or perhaps it is just that the young people are fairly bright.

88. If there are no further questions from my colleagues, is there perhaps anything further you want to say to us, Sir David?

(*Sir David Phillips*) I do not think so, my Lord Chairman.

Chairman] Then it only remains for me to say on behalf of all of us thank you very much for coming to see us this afternoon.

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HOUSE OF LORDS SESSION 1992-93

MINUTES OF EVIDENCE
TAKEN BEFORE

THE SELECT COMMITTEE ON SCIENCE AND TECHNOLOGY

SUB-COMMITTEE I PRIORITIES FOR THE SCIENCE BASE

Wednesday 24 March 1993

SCIENCE AND ENGINEERING RESEARCH COUNCIL

Sir Mark Richmond and Dr A E Hughes

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WEDNESDAY 24 MARCH 1993

Present:

Butterworth, L.	Perry of Southwark, B.
Chorley, L.	Porter of Luddenham, L.
Dainton, L.	Selborne, E.
Flowers, L. (Chairman)	Tombs, L.

Examination of witnesses

Sir Mark Richmond, Chairman, and Dr A E Hughes, Director of Programmes, of the Science and Engineering Research Council, were called in and examined.

Chairman

89. Sir Mark and Dr Hughes, you are very welcome. I think you understand that in this enquiry we are interested in the process of priority setting. We have no intention of trying to set priorities for you. We are interested in who sets the priorities, who monitors whether those priorities are upheld and whether across the whole system of support for science they amount to a coherent set of policies or are self-contradictory. If there are no coherent overall policies does it matter?

(*Sir Mark Richmond*) Thank you, my Lord Chairman. As far as the SERC is concerned I think that our objectives and priorities over the years have changed somewhat. You will realise from your previous experience what things were like a little while ago. In the early days the SERC basically had the objective and priority of supporting research in universities. As time has gone on we have moved more and more into the support of excellent research to underpin industry and commerce. A number of government initiatives have moved us in that direction. We now have two clear objectives in our remit, as are set out in our corporate plan.

90. If you have that point of view why are you not prepared to support institutions outside the universities altogether who also contribute to R&D of a fairly basic kind?

(*Sir Mark Richmond*) I think that in the past we have had an unwritten rule that we support work only in the HEIs or a limited number of other institutions. We are now broadening that to include institutions and other research councils. You will have seen from the report on biotechnology that we are now encouraged by the Minister to do just that in the area of biotechnology, but it has not yet gone as far as an across-the-board openness to all government research establishments of all kinds and complexions. My feeling is that one of the issues in the White Paper is whether the playing field will be so broad as to include all publicly-funded research organisations, or indeed all research organisätions. For example, I recently visited Thorn-EMI who were quite interested in the thought of a playing field which included research laboratories of publicly-funded companies. I welcome that we are moving in that direction.

91. On the other hand, if you were to spread support that widely—presumably if you did not have a lot of money to spread it with—the support of the science base in the old-fashioned sense of the work done in university and specialised laboratories would inevitably get less support in future?

(*Sir Mark Richmond*) That is right.

92. Is that the intention?

(*Sir Mark Richmond*) I do not think it is the intention but it would be an almost inevitable consequence. At the moment, the cards are stacked in favour of the universities in this context. But if the rules of the game change and the costings are the same in the universities as in government research or civil research establishments the inevitable consequence of the decision to have a level playing field will be that money will tend to flow away from the HEIs to whoever can do the work best.

93. I can see the logic of that position. On the other hand, the assumption that has been made by the universities and the university support system, as I have known it, is that the research councils will supply one side of the dual support system. I am sure that the funding councils still rely on the research councils to do that.

(*Sir Mark Richmond*) If I may say so, I think that that is unequal across the research councils. For example, the AFRC put only a very small amount of their resources into the system of support, but that is primarily a matter for that body, because this afternoon we are discussing the SERC.

Lord Dainton

94. Am I right in assuming that when you said you welcomed the notion of being able to give grants to appropriate bodies in industry for particular programmes that met with your approval you were also thinking in terms of recommendation 22 in your submission on the White Paper: "Relevant departmental research support activities should be transferred to the new organisations"? Were you seeing an accretion of funds coming to you for that purpose?

(*Sir Mark Richmond*) I am seeing the system working reciprocally; in other words, HEIs will be able to bid for work that is based on funds provided by other agencies.

95. Would the intention be to try to preserve that amount of money, or something like it, for supporting the science base and acting as a counterweight to what the Lord Chairman suggested?

(*Sir Mark Richmond*) Yes. I think the object of the exercise would be to try to support basic research on the combined resources available.

[Lord Dainton *contd.*]

96. The argument being that you are better placed to do it than government departments?

(*Sir Mark Richmond*) I would say that.

Lord Porter of Luddenham

97. In looking at the way you formulate priorities, it would be very helpful to me if you could explain how those formulations produced the result on the right-hand side of page 15 of your most recent report. That tells us that in setting priorities you have decided that physics and chemistry are worth 5 per cent, biology 2 per cent and physics, including particle physics and astronomy, more than 80 per cent. It is true that that is only 55 per cent of the total. There is another 45 per cent but it does not transform the situation all that much: chemistry is still 4 per cent and biology 7 per cent. Taking that specific example, can you explain those priorities and the relative importance of particle physics, chemistry and biology?

(*Sir Mark Richmond*) There is a strong historical imprint. The SERC council has taken the view that if one is to pay the CERN subscription—which is a governmental decision, not an SERC one—it is important to have a domestic programme that allows one to take advantage of that subscription: similarly for the European Space Agency and space. Having said that, there is also a strong feeling in the council that the funding of chemistry has suffered somewhat and is under-represented in our spend and that some areas of physics are over-represented. It is also complicated by the factor that just because the funding flows from a committee which is called a physics committee it does not mean that that is the only funding available. Chemistry is funded by a large number of committees. I think I am right in saying that only 50 per cent of the funding of chemistry overall flows through the chemistry committee.

Chairman

98. But are the figures in the diagrams those which flow through the chemistry committee?

(*Sir Mark Richmond*) The ones in the diagram are by the names of committees.

99. Not by subjects?

(*Sir Mark Richmond*) No.

100. Are you able to hazard a guess as to what proportion of the research grant money actually goes to chemistry?

(*Sir Mark Richmond*) We are in a position to tell you very precisely how much of the funding of chemistry in universities flows through which SERC committee and where the funding of each committee goes.

Chairman: Do you have the figure for chemistry in which Lord Porter will be interested?

Lord Porter of Luddenham

101. I think Sir Mark has already said that a maximum of 50 per cent came from the committee, bringing chemistry up to the magnificent total of 7½ per cent.

(*Sir Mark Richmond*) We would say that from within our own figures chemistry gets about 8 per cent, so there is a little bit from elsewhere as well. We freely admit that it is not as high as we would wish. We are now examining this with a view to making further adjustments.

102. Sir Mark knows that I bang on about chemistry because I am a chemist, although I think that biology is in an even worse position. Would he not agree that anybody from outer space, or anyone not affiliated to any particular discipline, would regard it as ridiculously unbalanced? More than 80 per cent on any judgment is going to physics. Is that his or anybody's assessment of the relative importance in the scientific world today of biology, chemistry and physics either from the practical point of view or intellectually?

(*Sir Mark Richmond*) I do not have to tell my Lord Chairman that there is more than one type of physics. The whole area of solid state physics is at the moment of enormous importance.

Lord Porter of Luddenham: That is part of the 12 per cent, which again is quite small.

Lord Chorley

103. I am not from outer space and I am not a scientist. It strikes me that the narrative is not very clear. It is referring to how committees spend their money. I would have thought that most people when reading this would say that chemistry represented 75 per cent. I think that the outsider would be struck by that.

(*Sir Mark Richmond*) We publish another document which is our core programme. It breaks our spend down into much greater detail. We are in the process of publishing this year's version of it. That will have a great deal of detail of the type which the noble Lord is seeking.

Baroness Perry of Southwark

104. I want to return to the answer given to the first question. I think Sir Mark said that the SERC supported programmes which in their terms supported British industrial effort, and so on. As a throw-away, he added that various government initiatives had driven it in that direction. Does Sir Mark believe that the various government initiatives determine the priorities in a fundamental way? Could he take us through the thinking that led him to feel that what SERC was about was supporting the superstructure of British industry?

(*Sir Mark Richmond*) Let us say that the issues we are addressing here apply with unequal force across the whole of the SERC. I think it is clear to everyone that the support of particle physics, and probably astronomy and archaeology, have much less relevance to wealth creation and the support of British industry than engineering and areas of chemistry. Across the sweep of our portfolio the application of force is unequal. We are significantly influenced by government policy. Usually it comes in the form of money for a purpose. For example, one can mention the ALVEY programme. That was a government programme that moved us in this direction; LINK was another. These are sums that

[Baroness Perry of Southwark *contd.*]

are available for a purpose, and interventions of that type by government—all of which latterly seem to have had wealth creation behind them—have had the effect of moving the focus of the research council from what I think in the Lord Chairman's day would have been the almost exclusive remit of the support of high-quality work in HEIs to one where it is qualified by consideration of the need for wealth creation.

105. Have you moved in that direction whilst believing that the funding councils' support for research in HEIs is able to determine different kinds of priorities?

(*Sir Mark Richmond*) My perception during my time with the SERC, and previously as the vice-chancellor of a university, is that the effect of funding council decisions, very much shaped by the availability of resources, has been to put the dual support system under enormous strain to the point where it has virtually broken down.

Chairman

106. In recent years?

(*Sir Mark Richmond*) Yes.

107. You have referred to my days which were 20 years ago. It was not the case then.

(*Sir Mark Richmond*) I agree.

Lord Dainton

108. Another external factor which means that potentially there is a lot of money available is the forthcoming Fourth Framework programme. That amounts to £10 billion over four years. Is that in any sense thoughtfully co-ordinated with what the SERC or research councils do? Do you have any influence over its shape? I ask the question because recently I was at a meeting of the Committee on Science and Technology of the European Parliament and was rather dismayed by the large amount of money slopping around, if I may put it that way, which was being tapped very successfully by many British scientists as compared with other countries. Do you take account of that money? Do you keep an eye on it? Does it enable you to use your own resources more economically?

(*Sir Mark Richmond*) As to the first part of your question, yes, we have an increasing say. The setting up of the Office of Science and Technology has improved matters in that respect in that the Ministers of that office now represent the United Kingdom in discussions in this area. We have a much more direct input than we had before the OST was set up. At that time our relations were through the Department of Education into the Department of Trade and Industry, so it was very much second hand. Things are improving. That is not to say that what we say automatically follows, but we feel that we are now able to put in a view. As far as monitoring the outcome of all this is concerned, we feel the outcome in financial terms in the sense that it leads to the process of attribution, which your Lordships have been into in the past and which perhaps we should not go into now. At the moment we are not taking real notice of where people succeed in Europe; we are regarding that as being adventitious to our main peer review system of funding.

109. To take the argument of the chemists whom Lord Porter regards as under-funded, it would be possible to consider the exploitation of the pot of gold in Europe by British chemists?

(*Sir Mark Richmond*) It comes back to a question we discussed a minute or two ago. In view of the nature of the Framework programme and indeed the Community which ultimately is an economic one, there are certain areas of research which are not of much interest to Europe. Particle physics would be one of them. I think that chemistry is rather different.

Chairman

110. You mean to the European Community rather than Europe?

(*Sir Mark Richmond*) Yes.

Lord Butterworth

111. Your document sums up this area by saying that in general the assessment of quality in Europe is subordinated to Community policy?

(*Sir Mark Richmond*) Yes.

112. Could you elaborate on that? I suspect that it is right but I would like to be filled in on that?

(*Sir Mark Richmond*) We strongly feel that the Community is pursuing a policy which means that frequently Community decisions are taken to use science and its support for basically social engineering ends. We find that the support of programmes requires extensive networking and networking requires participation of a range of countries which are not always chosen on the basis of the excellence of the science. They may be chosen for reasons more connected with cohesion and other preoccupations of the Community. That concerns us.

113. Therefore, the ordering of the priorities in the Community is less effective than ours. I suppose the question to be asked is whether that has any consequence for what is supported by them here?

(*Sir Mark Richmond*) I do not see a tight linkage of that kind. The assessment of quality within the programmes is always based on the objective of the programmes, but that is carried out by scientists. I am not so concerned about the quality of those judgments. What I am more concerned about is the amount of money that is put into various aspects of the programme: for example, the amount that goes into fellowships which have the social advantage of getting young people to move around Europe. That is all very desirable, and yet one is worried when the quality of the science that is used becomes secondary to it.

114. They are quite overt about it, are they not?

(*Sir Mark Richmond*) Yes; it is Community policy.

Chairman

115. To move back a step, it is clear that the idea of applicability is of increasing importance in your thinking. In my day it would have been said without any hesitation that science could not be supported solely or even largely through its applications. One

[Chairman *contd.*]

had to support basic research of the kind which people thought of as interesting or possibly intriguing. Now one has swung so far in the other direction of supporting things because one believes that they are applicable in a fairly short period of time, or because government or industry is interested in it. One wonders whether one has now reached a stage where the support of basic science because of its intriguing and intrinsically interesting nature has gone out of the window—at least in the minds of SERC. Would you care to comment on that?

(*Sir Mark Richmond*) I disagree that we have gone as far as you suggest. I am confident that we are still supporting a large amount of excellent fundamental work. I absolutely agree with you that without an effective pure and fundamental research base there is nothing to apply. One has to cherish that.

116. You say somewhere that what you are seeking is a balance. How do you define that?

(*Sir Mark Richmond*) It is extremely difficult to do so. If I may say so, one of the great problems confronting the Government in the writing of their White Paper was how to strike the balance between purposive science and, at the same time, not strangle the imagination, creativity and opportunity of gifted scientists. All I can say is that in the SERC we are very conscious of this. In the past my perception has been that when we have jolted in the direction of applicability it has usually been in response to additional funds.

Earl Selborne

117. Reading your submission to government on the White Paper, one of the difficulties appears to be that government departments in the past seem not to have been clear about their own research requirements or, even worse, have changed their priorities rapidly. You are particularly critical about the DTI. How would you like to be able to get closer to government departments in finding out what their research priorities might be so that you in turn could determine your own priorities?

(*Sir Mark Richmond*) That may lead to quite a long answer. There are a number of aspects. The first is that one would want to see that government spending departments had discernible science programmes which one could appreciate ahead of time. I have found it extremely difficult to discover what in prospect is the science programme of government spending departments. If you look at the various documents in the public domain you will find that individual departments describe their programmes with a very great variety of precision. I have found it extremely difficult—for example, in the build-up to the public expenditure round—to find out with sufficient precision what the programme of the spending departments will be so that there can be an effective dialogue. In my view, that problem is made a good deal worse by what I call the asymmetry of the relation. The research councils, being non-departmental public bodies, are outside the ring fence of government. Until recently the whole public expenditure procedure, whereby individual spending departments make their bid for money in the public expenditure round, has been covered by extremely low cloud. One is only now beginning to get glimpses of it, yet the reciprocal view—the view of the research councils from the spending departments—is very clear. The integration and co-ordination of the spend of a research council and a cognate government department is extremely difficult to work out in prospect because frequently one part of the story is hidden within government.

Lord Dainton

118. Will that be true in the future?

(*Sir Mark Richmond*) It is changing in the sense that we now do see a bit more but we are still unclear. I would say that up to the last election my impression was that the only policy of the Government overall with respect to science was to have no policy. The idea that one would see a coherent view, not a dominant instruction, as to what was in broad terms the science base strategy was totally absent. The part to be played by individual spending departments in that strategy was missing. In those circumstances, it was extremely difficult for a research council to interface with government.

Chairman

119. If one takes the Rothschild philosophy as he stated it many years ago, one may say that it is neither necessary nor possible to have an overall, coherent policy because each department must do whatever it has to do to meet its own objectives. That may not overall lead to any coherent policy. Do you have any comment on the position today?

(*Sir Mark Richmond*) One feels that it is necessary to be a bit more purposive than that. We come back to the central point that we made earlier: How does one have a strategy that is not a straitjacket?

Lord Chorley

120. There seem to me to be two central points: information and strategy. If you have the information I imagine that at least you will be able to plan your own strategy more effectively?

(*Sir Mark Richmond*) Absolutely!

Lord Chorley] There may be a good argument that there should not be a single, overarching strategy, but at least information is always a good thing.

Chairman

121. As you will know, a little while ago we did a report on the definition of R&D. Is what you are talking about a question of definition or something beyond that?

(*Sir Mark Richmond*) I think it is something that goes beyond it. It is a central issue which seems to be emerging, and it is an important issue that is emerging, in many countries. The new American Administration is saying very clearly that its spend on science has to be shaped to a degree in the light of the needs of wealth creation. The new German Minister, Matthias Wissmann, made a speech in Bonn about a week ago in which he said that from now on the German science spend would have the basic aim of enhancing wealth creation. The reaction of that and other western countries to the developing economic situation and demographic trends seems to

[Chairman *contd.*]

be that this public money should be focused, though perhaps not sharply, in a more purposive way to underpin wealth creation. If you are to do that you have to have more information.

Lord Dainton

122. That raises a very interesting and fascinating point. It seems to me that the SERC is trying to ride two horses at the moment: the pure basic science end, to use old-fashioned terminology, and the applied science end. The latter overlaps what the Departments are doing in an unmonitored way, though in theory they have definite objectives. One way of approaching it may be to say, "Well, this is a problem that cannot be solved on the straightforward, rational ground of philosophy and so forth. Essentially, it is a political decision and therefore the Government ought to take the decision on one basis or another", leaving you and bodies like you to look after the science base, accepting all the time that the boundary has to be somewhere. Someone has to take a decision. The argument as to wealth creation must be a political one?

(*Sir Mark Richmond*) I absolutely agree with that.

123. That simple sentence has a wealth of implications.

(*Sir Mark Richmond*) Yes. It has implications for the way the research councils go about their tasks, what is the role of the universities in relation to science and how one interfaces, integrates and co-ordinates what the research councils and universities are doing with the spend of government departments.

124. What you are doing is to try to load the future, in the sense of the science base and what it will produce in the way of wealth and the state of the country, against the needs of the present?

(*Sir Mark Richmond*) Yes.

Lord Tombs: I feel a lot of sympathy for Sir Mark and his sense of frustration in relation to government department objectives and performance in research. I have suffered the same thing myself in ACOST, for example. We spent many happy hours trying to understand the objectives of government. Those bodies have suffered one or two disadvantages, for which I see no ready cure. One is the autonomy of departments which leads to secrecy; another is the political nature of departments in which research plays a very minor part; another is the fragility of research done within departments. All of those factors lead to a situation of frustration.

Chairman: One hopes that everything you have mentioned is being dealt with in the White Paper.

Lord Tombs

125. One hopes so! I note that the administrative costs of SERC are 4 per cent of receipts or thereabouts?

(*Sir Mark Richmond*) Yes.

126. That is a commendable figure but not a complete one. A great deal of money is spent by various boards, committees and assessors as well as grant applicants. All of that really represents a percentage of the total science spend. I wonder whether you have tried to figure out the real administrative expenditure or, if you have not, whether you feel it is worth doing?

(*Sir Mark Richmond*) I think it would be a very interesting exercise.

(*Dr Hughes*) We have done it. I think we would need some notice to resurrect the figures for you.

Lord Tombs: They may be very illuminating.

Chairman

127. I think we ought to probe a bit more the fine detail of priority setting. Presumably, annually or every now and then the council or committees talk about what the priorities should be for the next few years. Can you describe that process? In particular, how rapidly does it lead to change? Is the change a very slow development or a complete turn about?

(*Sir Mark Richmond*) Perhaps I may first describe the structure and then explain the process. The elements of the structure are the SERC Council and the sub-set of Council which we call the Council Policy Group. They make recommendations to the council on the kind of issues we are talking about now. I am helped—as indeed they are—by a planning division within the SERC set up about two years ago. That marshals and generally develops the arguments for the Council Policy Group. The SERC year is basically divided into two parts. One part is dominated by the public expenditure round. That is the period from the summer break through to—let us say—the middle of February when the council is deciding within its allocation what it will do with its money and what additional bids it will make. This year and very acutely last year the preoccupation has been not so much with what additional bids to make but what cases to make to retain the lowest priority margin of the existing spend. That really accounts for the period from the summer break through to February. Increasingly in the period from February through to the summer break, ie the other half of the year, we are using the planning division and Council Policy Group to go over all the issues we have been talking about with a view to setting the financial allocation to the SERC Boards. As part of that we are beginning formally to think about a 10-year forward look. As your Lordships will realise, there are various elements of our spend, notably space instruments and things like that, which have a gestation period longer than the public expenditure round and the spend profile goes on at least 10 years into the future. It was becoming very difficult to manage the SERC's affairs without a fairly clear idea about some of the long-term very large commitments. That is one of the activities in which we indulge in the period between February and July. But we also look at some of the other issues. For example, at the moment we are looking at the balance between physics and chemistry. We look at other issues, for example what should our posture be in relation to the funding of biology. If one takes a subject like molecular biology, it is very extensively funded by the Medical Research Council, the Agriculture and Food Research Council, Wellcome and lots of bodies. The question is whether or not that has an impact on us. That discussion is going on at the moment and may well lead to a resetting of the

[Chairman *contd.*]

allocation for that period of time. That is the process we go through and the mechanism we use.

128. At that level of operation how free are you to set your own priorities? Putting it another way, how intensive are the pressures put upon you by other bodies, whether they be other research councils, government departments, industry or whatever?

(*Sir Mark Richmond*) We are very free in our spend where that is a flexible issue. For example, in the case of the engineering board approximately one-third of the annual spend turns over every year. There we have very considerable flexibility. We could change direction quite quickly. In other areas our freedom of manoeuvre is enormously constrained, notably in areas dominated by the overseas subscriptions. Both the CERN and ESA subscriptions are intergovernmental agreements for which we are the agents. Even if the SERC on the basis of their view of the science decided that they did not wish to continue in, say, CERN or the ESA one would not be in a position to stop; one would have to say to the Government, "That is our view of the scientific priorities". It would then be a political decision for the Government whether or not in the national interest the United Kingdom should withdraw. The extent to which we have freedom for manoeuvre is variable across the sweep of the council. I suppose that nearly one-quarter of our domestic funds must free up every year.

Baroness Perry of Southwark

129. Sir Mark, the process as you have described it is fairly top down, if I may put it in that way. Where do you see the input coming from for the decision that your Policy Group makes? Do you look to your boards? Do they give you feed back as to what is happening in their patch? How do you weigh one pressure against another? Do you take other things into account? What are you looking at over your shoulder as you make those decisions?

(*Sir Mark Richmond*) We have a very strong input bottom up in the SERC. In one form it is the nature of the bids you get from young (or not so young) scientists to do work. This is a measure of what people want to do. We pay a lot of attention to that. I think that that is one reason why the SERC has a fairly strongly historical imprint, in that the people you are funding are frequently those you have funded before who are on a roll. You get a flow through. I think that most of the information comes in at the committee level—from the third level down where one has very wide representation, particularly from people in industry and commerce in areas like those of the engineering and science boards. All the time there is an inflow of what people want to do. The boards have very considerable autonomy within their financial allocations to move direction in response to that kind of thing. I think it is quite important to have a bit of a drag in the system. Science changes but not electrically fast, as it were; when it does one becomes suspicious. One can go back to cold fusion. We did not fall into the trap of suddenly leaping into that.

130. On the other hand, there is the danger of running with the tried and true people whose work you know and simply going on running the same programmes?

(*Sir Mark Richmond*) That is right. I think that that is made worse by the fact that the overall funding situation is very tight and there are a very large number of good people who are putting in applicätions and have a great track record. If I have a worry about the SERC at the moment it is that we do not have enough flexibility to allow bright young people to come forward. That brings in the whole question of the dual support system. The universities are still receiving money for research. I would not want to see more money being transferred to the research councils because they have a job to identify some of these bright young people.

Chairman

131. To be quite clear, you do not wish to see more money being transferred from the funding councils to the research councils?

(*Sir Mark Richmond*) That is right. I would like to see that opportunity left with the universities who after all have the chance to spot them and bring them forward. It is the first grant that is always the hardest to get.

132. To what extent do you rely on bodies like the research councils and charities to pick the bright young people who, given the backing of those bodies, are likely to emerge fairly quickly and come to you for more massive support? In your policies and practices do you rely on providing that kind of support for bringing forward unknown young scientists?

(*Sir Mark Richmond*) I think so. My impression is that the council has from time to time made special arrangements to fund first-time grant-bidders. But all the systems which have been put in place have very much depended on the person at least having some track record. That is frequently provided by the universities.

(*Dr Hughes*) Broadly, that is true. There are exceptions, but track record is one of the things that committees are strongly asked to look at. They are also asked to pay special attention to younger people. Sometimes those things will conflict and a judgment has to be made. Undoubtedly, it is easier for a grant applicant to be successful when he or she has some reputation. Therefore, the pump-priming funds that are available within the university system to enable people literally to get off the ground floor remain very important.

133. I have been told more than once that in practice the SERC committees very often consist in terms of those who are present at the time of rather few academics—or, in the case of the chemistry committee, chemists—and a large number of other people, that is, assessors from government departments and what have you. In my day we used to call those people "goons" and talked about the "goon ratio". Speaking of the time before I became chairman, if it got too high we used to complain. I just wonder what the goon ratio is in your judgment?

(*Dr Hughes*) My Lord Chairman, you must have changed the system from what you perceived it to be before. Typically, a committee will have something

[Chairman *contd.*]

like 10 to 12 proper members—peer reviewers and experts in the particular field. There may be two or three assessors, sometimes fewer depending on the subject. There tend to be more in the engineering areas than in the science areas, because there are more other bodies involved in the same area of work.

134. One will also have programme directors, finance officers and people like that?

(*Dr Hughes*) Not at committee level. We have the committee secretariat to support the committee. At board level we have the attendance of someone at director level and the division head. But we try to watch very carefully the ratio of officials to others present. At particular meetings, if there is a poor turnout of "genuine" members of the committee, sometimes that ratio may appear to become rather large. I can assure you that we watch it carefully.

135. But at the critical level—the subject committee level—you are sure that the judgments made are dominated by the subject experts?

(*Dr Hughes*) Yes. Certainly, on standard applications for grants and studentships that is very much the case.

Lord Chorley

136. Excluding international subscriptions, what proportion of your funding is in the form of responsive mode and what proportion is in the form of the directed mode, if I may use that term?

(*Dr Hughes*) On grants across the whole council?

137. I was thinking of your funding excluding international subscriptions?

(*Dr Hughes*) That would beg quite a lot of definition questions about "directed" and "responsive". Broadly speaking, the split would be about 50/50. There is a higher directed component in engineering than in science.

Chairman

138. Is that the grant sums or the overall figure?

(*Dr Hughes*) I am taking a broad average across funding as a whole, but it begs questions of definition. I think we need to frame the questions a bit more carefully to be sure of the answer.

(*Sir Mark Richmond*) It is complicated by the fact that one has so-called initiatives where a general area of interest is announced and people are asked to bid in that area of interest. It is a combination of both. You say, "We are interested in *this* area of science and anyone who wants to work in it has to put in the normal grant application in that area".

Lord Chorley

139. But *grosso modo* it is about 50/50 excluding subscriptions?

(*Dr Hughes*) I think it is easier to think of it in terms of grants because in so many of the other parts of the programme—for instance, international subscriptions—we would not call them responsive or directed because they rely on an internationally agreed programme. But in the grants area the ratio of "directed" to "responsive" is about 60:40 in engineering and perhaps 45:55 in science.

Chairman

140. Are you sure you are not just following current fashion?

(*Sir Mark Richmond*) I would say that responsive mode funding is to a degree a protection against fashion.

Lord Dainton

141. I should like to return to the central question of setting priorities in another sense. From what I understand you to say there are two criteria which constitute a matrix, one of which is lack of applicability, or basically pure science, which is more at the utilitarian end; the other is excellence, with which you are very concerned. But there is another aspect which links you with other research councils. Your mention of biology has brought this to my mind. There are some coherent subjects, of which biology is one, which are supported by many research councils. How do you cope with your own priorities and how do you interdigitate your work so as to get a proper balance? For the moment, I am not thinking of the recent example of systematic biology which fell between the cracks. Are there mechanisms for the research councils to work together, or should that be a function of the ABRC?

(*Sir Mark Richmond*) I think the important thing is that it is done. If one takes biotechnology, there was a recent evaluation of just these issues under the aegis of ABRC. A table was constructed of various area of biotechnology and the research councils that are funding in those areas. It was a fairly complex table, and it was very interesting that certain areas had three entries: M for MRC, S for SERC and A for AFRC. I think that that highlighted where some attention had to be paid. Out of those discussions—in that case ABRC-led—the patch tended to get carved up between them, hopefully so that no-one dropped down the crack.

142. Did that happen right across the field?

(*Sir Mark Richmond*) No. Taking for the moment global environmental change, there is fairly active discussion between ourselves and NERC on who does what. It is a bit fraught at the moment, but the fact is that there is a great deal of discussion. That has reached the conclusion that, for example, we will build instruments on contract but not instruments as items of research if there is no scientific interest in doing so. Therefore, there is a very clear need for people to identify the use of data. In general, NERC use environmental data, and we are interested in devising instrumentation for providing that data only when there is a new science involved in the instrumentation. In that case the discussion is a bilateral one between NERC and ourselves. These discussions are going on multilaterally and bilaterally. At the moment, one area that has not been analysed enough is the area of support in the particular area of molecular biology where again in certain boxes one will find four letters, that is, Wellcome as well as the research councils.

Lord Butterworth

143. When the White Paper comes out are we likely to go back to the proposal that there should be a research council for biology?

(*Sir Mark Richmond*) I do not know. I think you will have to ask the people in OST.

Chairman

144. Perhaps we can come to structural problems in a moment. The more priority conscious one gets the more one has to probe how one goes about it. I would like to ask whether in addition to reviewing the priorities you have described you systematically look at areas of science and engineering which have not hitherto received priority treatment?

(*Sir Mark Richmond*) I think the answer is no, in that we do not have a regime of rigorously going round each area and asking that question on a two or three-year cycle.

145. Should you not do that if you are heavily prioritised?

(*Sir Mark Richmond*) If I may digress, there is another problem in SERC which in a way is a consequence of the past. We see ourselves—perhaps we should not—as a residuary legatee; in other words, the other research councils are much more mission-oriented/driven. We find ourselves with the job of covering the rest. In the past the fact that we did that, coupled with a higher level of responsive funding, meant that we did not at the time go through the analysis of the kind you have talked about as rigorously as perhaps we should. At the moment, the SERC has started to talk about the question whether it should withdraw from that residuary legatee mode and say that the main thrust of its work should be the underpinning of excellent science in the general area of physics, engineering and perhaps some areas of biology. But that raises questions about our role in biology. If we do that I think it follows naturally that we should see ourselves much more as a missionary council and we will have to re-examine our mission on a much more rigorous and formalised basis.

Lord Porter of Luddenham

146. I was very interested in your specific recommendation of the division into four parts, two of which would be MRC and NERC. The others are an industrial research organisation and cultural research organisation. From what you have just said, is the SERC going to be the cultural research organisation or will it be a separate set-up?

(*Sir Mark Richmond*) I just do not know.

147. This is very relevant to the setting of priorities. It could be a solution to the problem. If one goes along the German route, someone will ask of every application, "What use is this application for the purposes of wealth creation?" whereas if one splits the things as is proposed here that question will not be asked presumably in the cultural research organisation. There will be other priorities.

(*Sir Mark Richmond*) It is the subject of enormously active discussion within the research councils. The most extreme form of Lord Porter's statement is the ACOST view where one will have pure and applied research councils. That is taking it even one stage further. That is much disliked by many in the research council system because it is seen as splitting pure research from applied research. I do not think it need do that but it is beside the point.

148. Am I misreading this? It seems to me that you are giving to the Chancellor specific support for the splitting of the two functions?

(*Sir Mark Richmond*) The advice of the SERC that was put to the Chancellor was more ACOST-like than ABRC-like.

Chairman

149. Perhaps we may now turn to the structural side of it. Do you feel that ABRC fairly handles the demands you put upon it and fairly treats the priorities and objectives that you have?

(*Sir Mark Richmond*) I think it has an extremely difficult job.

150. As it describes its job to us, it tries to see that you carry out the missions which have been stated. But we have found it difficult to grapple with the idea that they interfere in any way with priority or objective-setting. It rather sounded as if they acted as auditors rather than policy-makers?

(*Sir Mark Richmond*) The trouble is that the ABRC has, broadly speaking, two tasks. Whether it has them or not, it has assumed two tasks. One is to make recommendations to the Chancellor about the way in which the available money should be partitioned between the research councils. The other is the giving of advice more generally on issues relating to science and technology policy. Having sat on ABRC in the past two years, it seems to me that those objectives get muddled and it is quite difficult for ABRC to shift from one mode of thinking to the other. I feel very strongly—and we have put in our advice—that in this area you have to separate rigorously the job of giving advice from the job of having an executive role to play. That is one of the problems that the ABRC has at the moment. By giving advice to the Chancellor which will be followed, the ABRC *de facto* becomes quasi-executive. It seems to me that that is a very unsatisfactory way to proceed. I would much prefer to see a separated arrangement where people gave advice and it was the job of others to put that into practice.

151. But there is an advisory body already. The more your policies and those of other research councils are tied up with the policies of other government departments the more important it is perhaps for an overall body to set the priorities?

(*Sir Mark Richmond*) In my view, the situation has been very unsatisfactory. We have an advisory board for the research councils which gives advice to the Chancellor of the Duchy. The Advisory Committee on Science and Technology gives advice to the Prime Minister. The first body is concerned primarily with the research councils and to a certain extent with the impact on the other spending departments. I imagine that ACOST's preoccupation is more with the totality of the spend. I am not very clear however about the extent to which they have gone into the Department of Education's concerns about the funding of research in universities for example. These are two lots of advice that are coming in at rather different levels. As head of a research council, from the outside it appears as though there is a vacuum.

[Chairman *contd.*]

That is not made easier by the fact that the deliberations of ACOST are private and within the ring fence. Although the chairman of the ABRC is aware of what is going on in ACOST because he is either a member or an attendant none of that is passed on at all to the research councils or ABRC under specific instruction. I think there was a dislocation between the advice that was coming in for the whole group and the advice that was coming in from respective research councils. ABRC also had two assessors, now three. Before the election it had an assessor from the Department of Education and Science. It had another assessor—the Prime Minister's science adviser. There was no input into ABRC specifically from the DTI, yet a great deal of what the SERC does with LINK, ALVEY or the teaching company scheme are conjoint programmes with the DTI. ABRC were getting a very partial view. That surfaced in quite different ways from time to time. For example, the funding projections within the SERC with respect to space had a rather direct impact on British companies in the aerospace industry, yet the ABRC was deliberating on a course of action which I think did not always or immediately take into account the wider ramifications. The situation was not working well. I would much prefer a system where there was an advisory committee which would cover the activities of all the spending departments, including the Department for Education and research in the universities.

152. ACOST is supposed to do that?

(*Sir Mark Richmond*) Let us have a continuation of that. I think there is a need for a much more rigorous system whereby the amount of money which goes to the individual research councils is decided by a group which may be internalised within OST and which will decide those points on advice from the other committee, separating the executive from the advisory function.

153. What is the role of the independents in ACOST? If that is such an important role, how do you see it reflected in what you have just said?

(*Sir Mark Richmond*) I think they have an impossible task. To be honest, some of the issues are extremely complicated. All of them are extremely able people who have other very demanding jobs. For example, Eric Ash is effectively vice-chancellor of a university with a very big spend. The questions that arise are extremely complex. If you are to have effective independent members on a committee like that giving advice they have to spend a great of time doing it. The piles of paper that come to ABRC are very large. To get people who are prepared to commit the time to be in a position to make balanced judgments of this kind must be a problem in any government advisory committee arrangement.

154. In the past we have toyed with the idea of saying there should be one research council, apart from the question mark at the back of our minds about medicine. In that case the need for ABRC would disappear. What is your comment now on that suggestion?

(*Sir Mark Richmond*) My comment is that I prefer the model (which perhaps I understand imperfectly) of the holding company in relation to subsidiaries. I think there is a case for saying that there should be a holding company whose job would be limited to a very narrow range. It would have the job of deciding what the division of resources of various residuary bodies should be. It should eschew micro-management.

Lord Dainton

155. But how can the body decide on what those divisions should be without understanding the work of the divisions?

(*Sir Mark Richmond*) That is absolutely right; they should understand the work of the divisions. But there should be a very clear distinction between the delegated authority of the divisions that are carrying out the policies.

Chairman

156. But would it have the right to reorganise the divisions?

(*Sir Mark Richmond*) It will have the effect or reorganising them by altering the allocation of resources.

Earl Selborne

157. I want to pursue a little further the distinction between advisory bodies and executive bodies. As I understand it, your present concern about ABRC is that its advice is almost invariably taken by the Chancellor, and to that extent the advice is in effect an executive decision. Your proposal is that you should try to put in place structures which very much separate advice from executive action. To that end you have within the OST a group which effectively has an executive function. Are you not simply saying that you would rather hope occasionally that the advice given by the ABRC was not taken in order that it could be shown to be only advice? Furthermore, have you not moved the executive action into a group rather like ACOST which is not seen and is not accountable to a wider constituency? Therefore, have you not achieved a far less clear definition of what is effective decision-making?

(*Sir Mark Richmond*) It is a problem. I feel that ACOST should give public advice, but the extremely difficult issue to resolve is what bodies you have and what are the rules of engagement. In a way, we are really talking about whether on the holding company model the holding company board is in the public domain or private within OST. My feeling is that for effective operation it has to be private within OST. But one has to have an ACOST that can give advice. There has to be a way in which public scrutiny can be brought to bear on the functioning of the holding company. At the heart of it is the question whether one can run those operations entirely openly.

Chairman

158. The holding company would be responsible for quite a lot of money?

(*Sir Mark Richmond*) Yes.

[Chairman *contd.*]

159. It would have to be accountable to Parliament through a Minister; it would have to be scrutinised by the House of Commons and therefore made public?
(*Sir Mark Richmond*) Yes.

Lord Butterworth

160. The holding company is really a euphemism for the abolition of the ABRC, is it not?
(*Sir Mark Richmond*) It would be a body that would take over part of the role of the ABRC.

Chairman

161. But in a clearly executive role?
(*Sir Mark Richmond*) Yes.

Lord Butterworth

162. Is there any reason why that should not be the OST itself?
(*Sir Mark Richmond*) What I am saying is that ultimately it is a matter for political judgment whether this becomes internalised within the OST. The question that arises is the extent to which the operation of that is subject to external scrutiny.

163. Am I right in thinking that an advantage of the ABRC is that there is an input from yourself and the other chairmen of the research councils which ensures that knowledge of what goes on in all research councils gets through to the decision-taker or advice-giver? The danger of any other system, particularly the OST taking over, is that enough information about what is going on in your council will not get through to the OST?
(*Sir Mark Richmond*) It is a risk, but the ABRC secretariat is a secretariat within OST at the moment. Why will the risks be any greater?

Lord Porter of Luddenham

164. In a sense, you seem to be saying that as far as advisory bodies are concerned you prefer to maintain ACOST rather than ABRC?
(*Sir Mark Richmond*) Lord Tombs was chairman of it for a while. I am not clear what the terms of reference of ACOST were, whether it was more than just to advise the Prime Minister on matters relating to science and technology. I would wish ACOST to have a view of the whole patch, to put it in the vernacular, and be in a position to have the necessary information on which to make a decision.

165. But you would want it to be more overt?
(*Sir Mark Richmond*) Yes.

Chairman

166. Formalities apart, what you are saying is that there should be a body advisory to government which would look at R&D or S&T across the whole front and all departments—not only the Department of Trade and Industry?
(*Sir Mark Richmond*) They must have a view of what is going on in industry and what the needs of industry are.

167. It would advise the Government very broadly. As far as the research councils are concerned, you would have an executive body whose main function was the allocation of budget between major divisions and structurally perhaps from time to time the rearrangement of those divisions?
(*Sir Mark Richmond*) Yes. I would also wish to see an arrangement where the spend of government departments was co-ordinated with the spend of the research councils.

Lord Tombs

168. As to ACOST, I have not been chairman for the past two years so I am out of touch. The terms of reference are very wide. When I was chairman the view was that the DES spend was a departmental spend and was a perfectly adequate structure. Although we took an interest in that it was dealt with in the same way as an interest in MoD, the Department of the Environment, Department of Industry and so on. I think that ACOST did a number of useful things in introducing post-decision appraisal, getting objectives clearly spelt out within departments and raising the level of science in departments with the aid of the Prime Minister. That was perhaps not very obvious, but it was very valuable. There is a fairly well established pattern of behaviour in government, in that advice given is not published except in very rare instances. I think that the Government would be very reluctant to do that. Frankly, I think that scientists would be reluctant to do that because they live in a confrontational political system. As soon as government receives one set of advice it becomes anathema to the opposition almost automatically. One has to be very careful about exposing the mechanisms of government decisions to the public eye just because of that consideration. To change the subject, I am a little puzzled by Sir Mark's view of ABRC. It seems to me that what he is advocating is the virtual abolition of the ABRC. I have been a member of ABRC and it seems to me that it performs a useful role in distancing government from the actual spend. There is a long tradition of no political intervention in the spend on science through the research councils. ABRC, if it does nothing else, creates that barrier. If we abolish ABRC and look to the OST we will lose that; we will quickly begin to have political interference in the science base. I am quite puzzled that the chairman of the SERC actually favours that route.
(*Sir Mark Richmond*) Maybe I am more sanguine but you are more experienced than I am!

Lord Dainton

169. The action taken by government and particulary the decision about the envelope of money to be spent is a scientific decision; it is a judgment. It is a resource decision but that decision cannot be made without giving weight to various parts of science. For example, one has to ask whether or not to go on with high energy particle physics when one is spending so much on it.
(*Sir Mark Richmond*) One could make a number of comments on that. We really have to turn to the discussion of who would be the chairman of the holding company? Would that be a

[Lord Dainton *contd.*]

Minister/politician or a scientist? At the end of the day, many of these questions are becoming increasingly political.

Chairman

170. That is why one has to examine the nature of the holding company very seriously. I am not convinced that it would not have to be a research council, perhaps under a different name. In our report on the science budget in 1991/92 we said that research councils were being required to make choices about some things which were too big to be left to the councils alone without political guidance. You are echoing that point, are you not?

(*Sir Mark Richmond*) Yes.

171. In asking you how you keep your priorities under review we never asked you how you tracked developments overseas which fell within your general remit?

(*Sir Mark Richmond*) I think we do it in two ways. We rely very heavily on the expert scientists in order for this to come to us bottom up. The Lord Chairman will know that the international fraternity of science is sometimes a great deal more strong than the national one. In many areas of science the issues come up from the bottom. You have to have your ears open to that, which I believe the SERC does. But questions whether or not to build one particular large machine or go into an international enterprise, or whether one should build it with a view to having an international enterprise formed round it, require close attention. At the moment there are plans or hopes to build a new generation neutron source. I am struck by the rapidity with which people who know about neutron sources are coalesced into informal international discussion groups that shape the future.

172. It is an international conspiracy!

(*Sir Mark Richmond*) Sometimes they can be very difficult for people with the money.

173. The other question is to do with interdisciplinary work. We all say that advances are very often things which are the subject of multi-disciplinary work. It has been my experience that consciously you have to seek out those areas; they do not occur naturally and are not part of the conspiracy, if you like. What do you do about it, especially as you are divided up into a number of different research councils?

(*Sir Mark Richmond*) I like to distinguish two kinds of interdisciplinarity. There is interdisciplinarity, of which examples are molecular biology and material science where it is the interaction of fundamental research work from areas which hitherto have been regarded as distinct disciplines. On the other hand, there is interdisciplinary work of which the new universities are particular practitioners. To take an example I looked at the other day, there is the study of fires in aircraft which combines finite element analysis with the properties of materials. Those materials may be metallic—the hull of the aircraft—or textile, such as the covering of seats, and so on. As far as the first area is concerned, one has to rely on the fundamental scientists. What worries me more is the type of interdisciplinary research that is much nearer to the market and draws on various bodies of knowledge. In a way, I think that that poses considerable difficulties for the way the research councils are structured. When I went to the SERC two years ago I had the rather bold hope that we would abandon the current board structure of the SERC, which was vertically monolithically based, and put in place a more horizontal one related to fields of endeavour. I had in mind a materials board, an energetics board and a resources and materials board. It got only half-way, in that we managed to make certain amalgamations. We tend to be linked to the historical view of the way the subject is constructed. The difficulty in this particular case was that, whereas I felt that there should be engineering in everything that the SERC did, the engineers felt that to have boards of the type I described where engineering disappeared somehow undermined their position in the world. I greatly regret that. Similarly, across the research councils we all agreed that there should be social science in everything. We have a social science research council. I am struck by the fact that on the mainland of Europe social science is imbedded in the science research councils which look after that aspect of the subject. I think it requires constant vigilance. The interdisciplinarity of the more practical type is posing the SERC some very interesting and important questions. Our peer review system tends to assess quality in terms of pure science and not quality in terms of interdisciplinary science of the type which will draw on expertise. We are just beginning to confront that in SERC. If we are allowed to survive—which I rather doubt in view of the White Paper—I hope to shift it one more jolt in the direction of being more interdisciplinary, which is another way of saying that we will redefine the way that science is organised.

174. At one time you had a joint committee with the ESRC?

(*Sir Mark Richmond*) We still do.

175. I thought you were thinking of abolishing it?

(*Sir Mark Richmond*) We were not thinking of abolishing it; we were thinking of asking questions about some of the work it did in certain fields.

Lord Dainton

176. But is it not true that none of these things can be said for all time? The matter has to be flexible and variable over time in relation to the state of knowledge and the state of potential areas of application?

(*Sir Mark Richmond*) Yes.

177. There has to be a constant interaction between all the research councils and other bodies as well as government departments, and in a sense you are moving forward by an iterative process?

(*Sir Mark Richmond*) Yes. I would be a little anxious if too big a leap was taken. One of the difficulties is that the shape of science is defined very much by the research system and its nature, but it is also defined very much by the educational process whereby young people come into it. The fact that we still have A-levels in physics and chemistry means that almost inevitably the universities have to have departments of physics and chemistry, and yet we

[Lord Dainton *contd.*]

still want to do research in material science. At some point there has to be a dislocation.

Lord Porter of Luddenham

178. I just wonder whether you will get anywhere with this. If you have just one research council there will be no problem at first because everything will be new. You will then have an enormous committee with everybody on it and you will have to split it into subjects. I question whether splitting it into material sciences, ecological what-not and so on will be any more helpful than splitting it into good old physics, chemistry and biology.

(*Sir Mark Richmond*) As my age increases I become more interested in history. I look back and find that at a certain point it was found necessary to construct the Department of Scientific and Industrial Research and it was then deemed necessary to disband it. People are now talking about forming it again. The wheel goes round and round.

Chairman

179. Is that the explanation of your remark that you may not survive the White Paper?

(*Sir Mark Richmond*) I think that the wheel turns and the chaff floats off!

Chairman] Sir Mark and Dr Hughes, you have been very generous of your time. Thank you very much indeed for your assistance.

Letter from SERC

When I appeared on 24 March 1993, with Sir Mark Richmond (Chairman of SERC), before the Sub-Committee investigating priorities for the science base, we were asked about the "hidden" costs of peer review (in addition to those direct administration costs of about 4 per cent of our budget which we regularly report). I said some estimates had been made and that I would forward further information to you. (Q 126)

The estimates I had in mind were those made by all Research Councils to inform the study of the Working Group on Peer Review set up by the ABRC and chaired by Professor Margaret Boden. The Working Group's report was published by the ABRC in November 1990. Chapter 5 and Annex C of the report give quite detailed estimates of the costs of peer review, particularly focusing on the time of peers.

For SERC, the Boden Working Group (using SERC data) estimated that "peers" spent the equivalent of about 13,200 days a year helping SERC work its peer review system. This included referee effort and time spent preparing for meetings. Depending on the charging rate used, this suggests a "cost" in the region of 1–2 per cent of the SERC's total budget, with the upper limit being very generous. These figures agree with similar estimates made by the DFG in Germany and reported in the Boden report.

The Boden Working Group did not attempt to cost the time of applicants in preparing grant applications (except to note that around 2 weeks per proposal was often involved) because this is part of the process of planning research, however it is to be funded.

I hope this information is useful to the Sub-Committee.

Dr A E Hughes

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HOUSE OF LORDS SESSION 1992-93

MINUTES OF EVIDENCE
TAKEN BEFORE

THE SELECT COMMITTEE ON SCIENCE AND TECHNOLOGY

SUB-COMMITTEE I PRIORITIES IN BASIC RESEARCH

Wednesday 21 April 1993

SAVE BRITISH SCIENCE SOCIETY

Professor J F Lamb, Professor R W Joyner, Dr M Freeman and Dr J H Mulvey

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WEDNESDAY 21 APRIL 1993

Present:

Butterworth, L.	Perry of Southwark, B.
Dainton, L.	Porter of Luddenham, L.
Dean of Beswick, L.	Selborne, E.
Flowers, L. (Chairman)	

Examination of witnesses

Professor J F Lamb, FRCPE, FRSE, Chairman, Professor R W Joyner, Dr M Freeman and Dr J H Mulvey, Executive Secretary, Save British Science Society, were called in and examined.

Chairman

180. Professor Lamb and your colleagues, you are very welcome here today. May I emphasise at the outset that we are not in this enquiry concerned with the total value of the R&D budget, whether the whole of it or the part related to basic science. We are concerned with how priorities are set, who sets them and whether they amount to anything at the end of the day. So may I start off by asking you, Professor Lamb, whether you would like to introduce your colleagues and then make whatever opening remarks you wish to make?

(*Professor Lamb*) Yes, thank you, my Lord Chairman. I am Professor Lamb, Chairman of Save British Science and a medical biologist from St Andrews University. May I introduce Professor Richard Joyner on my far right, a chemist from Liverpool Unversity who has also had seven years' experience in industry working in BP. On my left is Matthew Freeman, who is a molecular biologist from the MRC Laboratory for Molecular Biology in Cambridge and who spent five years working in the States and is also, as you will see, rather younger than the rest of us. On my right here is John Mulvey, our Executive Secretary, who is a particle physicist from Oxford University. May I say in passing, we tried to choose people who cover a fairly wide range of experimental subjects and also areas—I am from the far north and the others are from further south—and also to some extent a distribution of ages. We are grateful for the opportunity, as practising research scientists, to talk about the science base, and what I want to do is in two paragraphs outline briefly the areas of particular interest to our members, and we hopefully then can expand on that later. One of the questions you asked was, what is public expenditure on the science base for. We think it is to advance knowledge and train young scientists and engineers. It builds up a store of knowledge in the country and has important cultural effects. It also gives quite major economic returns for the United Kingdom, both directly and by new technical developments. We think it is essential for underpinning modern industries, but for wealth creation there must also be a large amount of research and development done by industry. You also mentioned the priorities for the science base and we think the first priority is to attract world-class scientists and engineers across the whole spectrum of recognised disciplines. They are then the best judge of the priorities of their area, but to work effectively they need a diversity of funding sources and mechanisms, including the long-term funding embodied in the dual support mechanism. Finally, my Lord Chairman, our science base is still quite strong but we think it is weaker than it should be; full health can best be restored by adequate finance and by structures which allow as many priority decisions as possible to be taken by the researchers themselves.

181. Thank you. I do not know whether any of your colleagues would like to add their own gloss to what you have just said?

(*Dr Freeman*) No, thank you.

182. May I start off, then, by reminding you that the Government in general and the SERC in particular seem to think that there should be more emphasis on wealth-creation as a motivation for basic research. If that is the case, whose problem really is it to set priorities for the science base?

(*Dr Mulvey*) As we have already said in our opening statement, there is a strong relationship between a successful science base and wealth-creation in the country. I think, though, one should start by being careful to define the criteria for research within the science base versus research, within industry. We have just said that we believe that the primary—not the only but the primary—criterion for research in the science base is advancement of knowledge, while in industry it is wealth-creation. I think one begins to get into difficulty if one tries to mix and confuse those criteria, and there is a danger—we see it in the views you alluded to—that largely because of the historical weakness in many sectors of British industry, weakness in exploiting the science base, there is a natural temptation to try and put that right by manipulating what goes on in the science base. We would argue you must keep these things clearly separate, and not try to distort the priorities in the science base. You have said that we should not talk about funding, we certainly take that point, however, we are talking about priorities and I do not think one can look at priorities just inside the science base irrespective of what is happening in terms of national priorities as a whole. For example, if you look at the national expenditure on research and development as a whole, 23 per cent goes into defence, 54 per cent goes into civil research and development funded by industry and other bodies, and if you look at the science base alone, taking the research councils and the higher education sector together, it is about 14 per cent. If you now come down to the five research councils, it is about half that, 7 per cent, and most of those research councils have some mission although they do basic science as well. Professor Richmond is

[Chairman *contd.*]

Chairman of the SERC which at least has a mission to support basic science. The SERC alone is 3½ per cent of the total and we would be very worried if within that 3½ per cent, for that part of it which still remains for basic science, the priorities begin to be distorted in a way which tries to solve the much bigger problem of why we are not spending more in industry than the 54 per cent. So while we see the need to help industry, we think that other sectors of Government are not pulling their weight. For example, the Department of Trade and Industry has actually reduced its expenditure; when it should be helping industry and helping at the interface between the science base and industry, it has reduced its expenditure by £200 million a year. Now, instead of trying to distort the SERC, what one should do is look at the bigger picture and ask what as a whole is being done and, for example, if there is more help required why do we not get more from DTI?

(*Professor Joyner*) My Lord Chairman, we believe the approach that industry has to the priorities within the science base is really rather the same as ours. As our Chairman has said, my contacts are primarily with the chemical and pharmaceutical industries and these are still among the United Kingdom's successes. My friends who are industrial managers recognise the importance of the training function of university based research and believe this is best served by allowing people the opportunity to take on problems which are of interest to them in the context where they can do the best possible work in an international context. I think SERC found this to be the case as well. They produced a document two years ago called 'The Science Board and Industry' and if I can quote from that they say: "Surprisingly, industry is little concerned about the balance between curiosity and strategic research." Industries' interests are really to see the training function and the excellence that we have said should be the priority for the science base maintained.

183. Sir Mark Richmond when he came to us said something that went a bit further though than what you have quoted and implied. He actually said something to the effect that he would put SERC money into basic research wherever it was found, not confining himself necessarily to the universities where it has been going in the past.

(*Professor Lamb*) Yes.

184. That could mean that he could be funding industrial research laboratories, all sorts of things. I wondered what your reaction was to that? Your interest is in saving British science, not British universities.

(*Professor Lamb*) Yes. We have, of course, Lord Flowers, had discussions on this because as we heard it from the Government, it did not seem a particularly well thought out strategy in that we felt it would dilute the already small amount of funds which are going to universities. In order to have a level playing field we thought that university people ought then to be able to apply for money from DTI, from defence and so on. That was our general picture.

(*Dr Mulvey*) My Lord Chairman, we are deeply concerned about this tendency and we saw a report of your meeting with Professor Richmond. There are almost uncountable difficulties that, I think, most of us see in that proposal. Most research—not all of it perhaps—but especially research in the science base is very difficult to liken to going out to buy a can of beans. It is easy to say: "Shall we buy a can of beans at Tescos or go down the road and see if Waitrose will give us a better deal?" In many ways research, especially basic research, cannot be defined in such simple terms, you do not even know what is going to be delivered until the work has been funded and done. In particular when it comes to the universities I think the definition of a level playing field is, if I may say so with respect, the sort of thing one finds in theoretical physics where you have a perfectly flat horizontal frictionless surface on which bodies slide. In real life there is no such thing as a level playing field. Indeed universities supply quite different goods along with the research they supply. It seems from what is being said that this again, although it is not explicit, implies a clear separation between teaching, training in research, and the research function. Or you have to value the teaching and training in some way. I have several other points. Let me go to one which we think is particularly worrying. The science base is already very competitive, mainly in terms of who has got an original idea or a very good experiment. These proposals would make it, in my view, more competitive in an additional way: in methods and much more competitive in costs where methods are very important. Details of techniques do not always get published but they are swapped around at meetings, at coffee tables at conferences, people talk to each other: "I would like to do so and so but I cannot seem to make it work" and somebody else says: "Well, look, have you tried it this way." The whole success of the science base relies upon a free exchange of information in the science base, not only internationally but also nationally and even within departments and between departments of the same universities. What I fear (and I say this because I have seen signs already which are a result of the competition for money) is that people will become less inclined to talk to each other if they are transferring something which might give an advantage to somebody else to bid for a contract. It will, I think, make it harder for university people to talk casually with people in industry because industry will be competing, perhaps, for the same contracts. It could lead to a closing of doors.

185. May I just ask you this: whether in fact you are conscious of there being any priorities? If there are priorities it means somebody, SERC or somebody, has laid down that more money should be spent on certain activities than on others and you may or may not agree with the distribution of money that they have decided to impose, their priorities, and you may or may not like them. What I am asking you is whether you are conscious that there are priorities and sums of money are allocated in ways which fit those priorities rather than even distribution or whatever?

(*Professor Joyner*) I think one has to look at the issue of priorities in a broader context. Priorities within science are set in a number of ways, they are set by society, for example, which sees an illness like AIDS and regards it as a priority where something

[Chairman *contd.*]

must be done. Priorities are set also within the science base by industry and the extent to which industry is supporting the science base is also important. There is another aspect of this which I think is perhaps insufficiently considered and that is the extent to which priorities in a sense are set by serendipity. Two scientists of IBM in Zurich pursue a crazy idea which comes up with high temperature superconductors and that whole area takes off. This is something which people have tried to plan for and on the whole have failed to do so. What we would urge upon your Lordships is the importance of the extent to which priorities within the science base should be set from the bottom up rather than from the top down.

Earl of Selborne

186. If I can pursue that, a plan for serendipity is always a real challenge for a research manager. Would you favour transferring funds away from the research councils back to the funding councils? Presumably the universities have a better track record of identifying people rather than products?

(*Professor Joyner*) What we have said in our opening statement is that we believe that it is important to have a diversity of funding sources and mechanisms. Those countries which show the best ability to take advantage of serendipity are those where there exists such a diversity of funding mechanisms to support it. We certainly believe that the dual support system has an important role to play because its continued dismantling would be a serious disaster for the country. Similarly, the idea that there should be one single research council, which would know everything and would set all priorities within science, would seem equally to us to be unwise.

(*Professor Lamb*) We have already sent you our document on this in support of the dual support system.

Lord Porter of Luddenham

187. Could I follow up Professor Lamb's opening statement because he did there make a brave effort to tell us what the priorities were. Mostly the talk is about how one can transfer money from here to there but this was priorities. What you said was that the first priority is to go for good people, to attract good people. Immediately following that you said they are the best judge of the priorities in their areas. I think everybody here would agree with both those points but then we come to what I believe is the main problem that this Committee has to settle. How do you decide priorities between areas? These specialists who are peer reviewers in their own area immediately become very motivated by their own subject and it becomes a choice between areas. This is a difficulty that the research councils have, it is a difficulty that the Government has. How do we decide? After all, there is £400 million, is there not, available to the research councils, however small a proportion of the total that could be made out to be, and yet we find that, as we were saying at a previous meeting, some 80 per cent of the SERC funding goes to large-scale big physics, 7 per cent to chemistry, 4 per cent to biology. Whether that is right or wrong I do not want to argue but how are these settled? We asked Sir Mark Richmond that and one of his answers, his main answer, I think, was that it was largely historical. Is that the way to decide priorities? If not, who would you propose as the right body to set those priorities—the Government, between the various science branches, between space exploration, astronomy, small chemistry and the little things that Professor Joyner has just referred to which prove to be so successful for so little money sometimes, serendipity?

(*Professor Lamb*) At the next level up from the individual or the group of course you would have the research council and if we do not take SERC for the moment but take the MRC, which does not have these large external costs, then this is a matter of peer judgment between the people who are currently on the MRC committee, so this is the next level up. These people have done good work and are well-known workers in the field, so they then make a decision over that part of the field.

188. That is easy, is it not, because it is comparing like with like to some extent?

(*Professor Lamb*) Yes, that is right.

(*Dr Mulvey*) My Lord Chairman, as Lord Porter says, this is clearly the most difficult question. It is the same question that governments and those resourcing science and the science base find in all countries and I think inevitably there must be an element of the historical. You have commitments to international collaborations, you have commitments to major facilities. I would just comment that, of course, the major facilities, especially in the SERC case, are used by university scientists, sometimes quite small groups of scientists using an instrument like the synchrotron radiation source at Daresbury. These are facilities provided for the benefit of the community at large, not just for the laboratories that house them.

189. Would you agree that very often the community does not ask for these facilities? They do sometimes but not always.

(*Dr Mulvey*) I think the programme at Daresbury, for example, is absolutely full, and the competition to get on to facilities elsewhere, as far as I know, is also full. Perhaps Professor Joyner will add to that in a moment. I do not believe that anybody is going to give you a formula that says all you have to do is set up this particular set of committees and they will give you the answer. I think it will be a continual struggle for all the people in responsible positions who have to face this task. I think we will probably come to the structures in a minute but at various levels the Government will need advice, not just from the scientific community clearly but from well-informed individuals from other sectors, from industry certainly and politicians will play a part.

Chairman

190. Could I ask you to be a bit more specific. Lord Porter clearly feels—and I have every sympathy with him—that chemistry could do with a bit more money and physics, or big facilities at any rate, could do with a little less. That is his privilege to feel like that. May I ask you how you feel about the science vote as a whole? Do you think it is distributed amongst various subjects in a reasonably fair way? Perhaps

[Chairman *contd.*]

"fair" is the wrong word; "productive" might be a better word. There are various words you can use, but do you feel that the way the money is distributed accords with your sense of what the priorities ought to be? If not, how would you change it?

(*Professor Lamb*) Could I put in a little bit before we deal with that?

191. As long as you do deal with it, yes!

(*Professor Lamb*) Part of the problem is that we do not regard ourselves as being in the business of having to make that decision really. That is a caveat. May I just draw Lord Porter's attention to the paragraph in my opening remark, saying that we need diversity of funding sources and mechanisms in addition to our dual support mechanism. The point of putting that in was exactly to answer your point, that is, that good science ought to be funded from somewhere and this is a way of doing it, by a diversity of inputs.

Lord Porter of Luddenham

192. The word "plurality" has actually been used by Mr Waldegrave himself.

(*Professor Lamb*) That is right, yes.

Lord Butterworth

193. Would you admit that there is always going to be so much good science that there will never be enough money to fund it all?

(*Professor Lamb*) Yes, I think that is right.

194. Therefore priorities have to be decided?

(*Professor Lamb*) Yes.

195. It therefore becomes your responsibility to tell us how you would like to see the machinery designed in order that those priorities can be more efficiently settled.

(*Professor Lamb*) You are certainly pushing us on this point, Lord Flowers.

Chairman

196. That is what our enquiry is about, you see!

(*Professor Joyner*) The first point I have to make again is what Professor Lamb has said, that we are not in a position, nor do we have the resources, I think, to tell you specifically that SERC's cake should be divided up in a different way. What I think we can do is to give you criteria which will lead to the most effective division of the science vote, whatever it is. One of those is diversity of funding, which we have already discussed, but the second one, which we have also alluded to, I think, is probably the most important one and that is the question of excellence. I have alluded earlier to the question of AIDS. AIDS is clearly an important priority for society but it is nonetheless debatable whether, for example, third-rate research in AIDS is of any more use to society than first-rate research in particle physics. The equilibrium, as you will all be aware, is really a dynamic equilibrium and the result is best achieved by having a situation where there are as many inputs and as many opportunities for people to influence the debate as possible, and since we have emphasised the importance of setting priorities from the bottom up, one of the things that we also believe is significant is that people at an early stage of their career should be involved in the decision-making process because those are often the people who have most to contribute as to where real advances can be made.

Baroness Perry of Southwark

197. That chimes very well with quite a lot of the evidence we have had from other people, about the importance of the young scientists developing their own creative ideas which perhaps nobody else has thought of. What we have heard from some of the young scientists is that they find themselves defeated in that object because they have to slot into the large rolling programmes where there is available funding and where they are on short-term contracts. Very often, they are selling their wares, and the serendipity that you quite rightly urge, for many of them, they perceive, is not happening because they are always working on other people's priorities.

(*Dr Freeman*) I take your point very strongly. I think you are absolutely right, there is a real problem with young scientists getting their first independent position. I also think there is a problem beyond that stage, that is how independent they really are. Yesterday I did a straw poll amongst colleagues, since in my own relatively privileged position of working at the LMB I am generally well funded and things are easier than at many of the university departments, but I called round some colleagues and talked to them. The overwhelming message that I received was that in those cases where they were able to apply for ear-marked or targeted funds in a particular field, where perhaps the science board of the SERC had made a rather specific choice on a field that was to be funded, they all to a person said in those cases the grants being funded were relatively mediocre compared to the case where they are in open competition in a much broader category. I think that is a very telling point because it is a concrete example of the point my colleagues have made that where the priority setting is allowed to become to specific that is often a recipe for mediocrity and not for excellence. What we would argue very strongly, as we have said, is that within the hideously difficult problem of how does society as a whole make its choices between the broad areas, the main criterion that we would like to have used is that of scientific excellence regardless of the specific topic.

198. Would you then say the logical conclusion of that—and I agree with it—is that there ought to be a distinct lurch in the budget setting of the research councils so that there are many more free grants which are bid for by individual teams than the large rolling programmes in designated centres and so on?

(*Dr Freeman*) Well, within my limited experience of having been back from America for only a year and also being in the privileged position at LMB of not myself having to write grant applications, yes I would. Anything which encourages scientific excellence as being the main criterion I would encourage.

Lord Porter of Luddenham

199. You would go so far as to have open competition between the young scientists in MRC and the Rutherford Appleton Laboratory with the universities? This has been proposed.

(*Dr Freeman*) Yes, I do know. We are back to the crux of the problem which is how you set the broadest sweep of priorities and I think it is legitimate and reasonable that such broad categories are set. For instance, society as a whole in some rather general way decides that medical research is a good thing, or that strategic committees which include informed scientists decide that material science is an important field. Within those categories, and assuming the diverse funding mechanisms we have already alluded to, I would like to see as much open competition as possible.

(*Professor Lamb*) If I may just add we think the dual support mechanism is very important in this and we greatly regret that it has disappeared, or has virtually disappeared. Now one can get very little support directly from the university. This was a way of giving all the young people access to money to start with.

(*Dr Freeman*) Maybe I could just take up then one more specific point? In the straw poll I did—it is totally unrepresentative, I spoke to about six people yesterday—I asked them how the set-up funds they received from their departments here from the dual funding mechanism compared with what they would have received in America? (A lot of them had done post doctoral work abroad and decided to come back, incidentally I do not think any single one of them came back for scientific reasons, I am afraid to say, I think almost everyone came back for personal reasons.) I was absolutely shocked, to be honest, because in my own position it is not something which I have actually come up against personally, but I got a range of the start-up money that young independent scientists were being offered of £2,000 from a department with a five rating to £17,000, which was again another department with a five rating. In America my colleagues getting absolutely equivalent jobs were negotiating around 150,000 dollars which was a sort of standard set-up grant. One of the arguments has always been that in Britain we have the concept of a well found department, so that you do not have to buy your own equipment, like ultracentrifuges, because they exist in the department. I think with the DR shift that is becoming less the case, and with the smaller amount of money for the department as a whole, people are having to buy their own equipment. I was absolutely appalled by that and it did suggest to me why it is so difficult to get people back into the country.

Lord Dean of Beswick

200. I have got a copy of your correspondence to Mr Waldergrave dated 27th December and you do mention I think in one paragraph the USA again in that. Surely those are not the only people that we are concerned with in the question of competition. Having said that you do say in the submission that you would recommend a substantial increase in Government funding of research and development, I think you say an increase of £400 million up to a certain date, £800 million by the turn of the century. Now one of the other major components of funding research in this country—and it has been touched on today—is industry itself. Now industry, with the way society has developed and the world, is no longer based on national industries, it is based on international industries. If you are a multinational industry and you have substantial plants in the United Kingdom, substantial plants in Europe and substantial plants in other parts of the world such as the fastest developing one of the lot, such as Japan, is it not a direct incentive for our industrial people to put their money if they so desire in a country whose Government is far more generous or far more able to provide more money from the centre or from the taxpayer towards research rather than our own which is possibly, I would suspect, towards the bottom of the international league. Having said that, can I jump forward to after the circus has ended at the other end of the corridor on Maastricht. You do not even mention Europe in this. How will people like yourselves be affected, or will you be affected, by what takes place when Maastricht comes about, as it will, or will the international industrialists expect to put their money in a country where a certain line of development is taking place that is perhaps doing rather better than us?

(*Professor Lamb*) We have indeed, of course, discussed this but in our opening statement we wanted to keep it rather short; we did not want to spread ourselves too much.

201. Surely you are going to be faced with that situation?

(*Professor Joyner*) One of the reasons we have continued to be successful in the chemical industry, in the pharmaceuticals industry, is that we still have a strong science base in those areas and the interaction between that science base and the industry is something that industry, as well as the scientists, regards as extremely important. I know that this Committee is not concerned with funding but I know that in a number of submissions that have been made to you industry has made the point that they are concerned at the erosion of the science base. So provided that the science base is healthy, provided it deals with the points we have been attempting to address, then these companies will want to research in this country, will want to support research in this country and, indeed, companies from outside will still want to come here. So I do not think that we are concerned by international comparisons in that way. I think also we believe that the approach where, on the whole, British scientists are allowed to do their own thing at an earlier age than is true in many other countries, is a strong point. The question that you raised with regard to Europe is, I think, in the specific context of the Maastricht Treaty and I do not think that is itself something that has any great part in what we are trying to talk about today. On the other hand, the approach of the European Community to funding is one which is very serious and one that is of considerable importance to us.

202. Can I put it rather more crudely. Is it not possible with the present system for a country, by putting more Government money in than we are doing, to buy research away from this country? For instance, if Japan wanted to do it, they have lots of money.

[Lord Dean of Beswick *contd.*]

(*Professor Lamb*) May I address that and also say that what we would like to do at the end is to give you some further submissions. One of the documents that is extremely good on this is by Keith Pavitt. I think he is an engineer who has turned to be a social scientist at the Science Policy Research Unit at Sussex and, therefore, he is used to working with industrial things. He has a lecture, of which I have a copy here, almost addressing that point exactly. Let me illustrate one or two points. It turns out that industry has to work much harder to get ideas from laboratories that are at a great distance. The Japanese have, in fact, been very good at doing that and British industry on the whole has not been very good at doing that. Part of the mechanism of that is interesting: when scientists trained in a first-class research laboratory, move into an industry in Britain, say the pharmaceutical industry, into Glaxo or whatever, they take with them their knowledge and also a network of contacts. It turns out that, if you look at selected industries like chemical and pharmaceutical and so on, half the ideas that they have taken up are not from the literature but from people. So it is very important for the people to move from research laboratories into industry. That is part of the reason. There are all sorts of other reasons. Let me give another quote from Pavitt: "basic research augments the capacity of technological practitioners to solve complex problems, especially when the practitioners have research training themselves." So there is quite a literature now on this and we would like to submit it to the Committee at the end.

Lord Dainton

203. I wonder if we might come to the central point, which is this: there is an envelope of money which is available, which is not going to be changed. That is the starting-point at present that we are at and we are trying to find a better way of devising priorities, therefore of finding better criteria for the science base. Whilst I have been here I have really heard very little except a plea for support of the young scientists at the beginning, because that is the most creative period and, of course, it is a point that I have advocated for 30 years at least, but somebody has to take decisions. Can you offer us—this is what we are really seeking—guidance on some of these matters? For example, how much of the total amount of money available would you let float free for young people, how much would be targeted, to what areas and how would you rank those in priority? Do I get the impression from what Dr Freeman said that he wants no targeting of any kind, because in some subjects, of course, you do not get the benefit of the work for ten years, if you think of nuclear physics or astronomy or whatever? Therefore, you have to have plans laid early ahead. Have we got our priorities wrong? What would your priorities be?

(*Professor Lamb*) May I ask for clarification. Are you including all research spending by the Government?

204. No, just the science base.

(*Dr Mulvey*) My Lord Chairman, I do not think I am going to satisfy Lord Dainton on this one. As Professor Lamb has already said, we clearly accept that there have to be priorities and a mechanism needs to be set up. The mechanisms exist today: there is ACOST, there is the ABRC, there are the research councils, and they quite properly take a broad view of what is happening in the research base and make sure that within certain areas, let us say materials science, we have a viable activity, and chemistry, of course, as well. I am sorry but I have to repeat what our Chairman said and that is that we have not, and have deliberately not, addressed the issue of whether the balance is correct, whether we have too much or too little chemistry, too much or too little materials science. You have talked to the Chairman of the ABRC, you are talking to the heads of the research councils and to the HEFCs, and I am sure these are questions you will address to them. From our point of view it is clear that one has to have a structure of that kind. In our insistence on the dual support we want to make sure that in parallel with the system which makes sure that there is activity in certain important areas, there is also an upward, from the bottom-up, initiative possible for individual scientists. That is why we put so much emphasis on dual support. How are you going to make these decisions about what is the balance between materials science and biotechnology? That is a very difficult question. To come back to a remark made earlier by Lord Porter, I do not think we are ever going to find it possible to have a sort of open competition on individual grants from individual scientists in, say, materials science versus astronomy. The structures that we have to live within will have to decide that there is a certain amount of money for this area, a certain amount for that area. The question you keep coming back to is, all right, what is that structure, and we do not presume to say. We certainly cannot give you a magic answer for that. We can make comments on the existing structures. Clearly Government—and Government has the main responsibility because it is the Government that must fund the science base whatever else it does—must take advice. You need to form policy. There are at least two levels. There is a policy-forming level and there is an implementation level. I think the very broad issues come quite high up in Government. This is where ACOST perhaps comes in or some replacement of ACOST. I think we would like to see a replacement of ACOST which is more effective and perhaps more tightly coupled with the actual decision making process in Cabinet. We have referred to the President's Council on Science and Technology in the United States which seems to be very tightly tied in to the different structures. That body must have advice from scientists, from industrialists, from other sectors of the community and they will have to struggle with those issues. Do we or do we not decide to continue with particle physics, for example, or whatever? These big decisions take place partly there, and that in fact determines the envelope within which the science base has to work. Then there is a level lower down which should look across the science base but not just the science base, should couple in what is happening in other areas, in the Department of Trade and Industry, for example.

Chairman

205. Forgive me for interrupting, this is very interesting but we have questioned quite a few of the people who are engaged in just that sort of thing at

[Chairman *contd.*]

the present time and we shall be questioning more before we finish. The question that we are trying to get you to answer is: given the present distribution of resources over subjects and given that that total sum is fixed, which is the position of our enquiry, do you think it is reasonably distributed and if not how would you change it? We have talked to these very important people but we are now trying to find out what the workforce thinks. How do you find the situation: good, bad or indifferent?

(*Professor Lamb*) The kind of way I would reply is to emphasise the dual support. We think it was a mistake to reduce the DR element and move it into the research councils because this has led to a great deal of problems in universities. So that would be one advantage of our recommendation that the dual support should be increased from what it was and certainly should not be decreased further. Secondly as we have said in our opening statement, you will not get very good science unless you get very good scientists and science is becoming less attractive as a career. Therefore we think you need to get mechanisms to get very good scientists and engineers into the universities and in order to do that you need to allow them to get access to money initially and then to get access to money through the research councils. We would be against any direction by the research councils that could move a lot of money away from individual grants. We would also have views actually on the wider thing, we think there is too much money spent on defence R&D.

206. I am sorry: that is quite outside the terms of our enquiry. It is an interesting point and I do not wish to suggest the Committee is not interested in it, but it is not the subject of this enquiry.

(*Professor Lamb*) Yes.

Lord Dainton

207. Following on, if I may, from a remark which you made a moment ago over this question of attracting good people into science, salaries, as was mentioned earlier, are not an attraction, indeed I think Dr Freeman referred to that. Given that something like 75 per cent of the expenditure in science is in fact on salaries, how do you finance more people in within a fixed budget?

(*Professor Joyner*) The simple answer to that is that it cannot be done.

208. Yes.

(*Professor Joyner*) The problem we have been concerned with is that those people who are there, are not being adequately supported. What you are asking is something which cannot be done.

209. The next thing you say is, if you do satisfy that condition, you get less work done in a particular area, and that sharpens the needs for priorities even more. I think we are going to be in that situation for some time with the best will in the world. Again I am coming back on how one develops criteria, excellence you have all said but then there is excellence in subject A, which is deemed to be for some reason, it may be they have developed too strong a hold on a break-through in molecular biology, some such thing. Who is going to keep a eye over the whole field and keep the balance?

(*Professor Lamb*) This is why we want a diversity of funding sources. In fact, if I take a historical example, I think the original work on DNA in Cambridge was not funded by the research councils but came from the physics department, as I understand.

210. I was there at the time and that is not strictly true, I am afraid. The position was that Bragg took the idea to Sir Harry Himsworth, Bragg happened to be head of the Cavendish but it was the Medical Research Council, after the Society for Protection of Science and Learning had ceased to support the ex refugee scientists. That is a common mis-perception.

(*Professor Lamb*) Thank you for correcting me.

211. If I just come back: this is our central problem, we would like to be able, knowing the bounds which have been set by Government which we cannot alter, we would like to know if there is a better way in which these decisions can be made? Now every time one goes to this problem, as I know from my past experience, you find if you want to do something new you have to drop something old. It is that kind of decision. When does one stop and where does one start and there are some things you have to start for perfectly good reasons when people are not already there. We see that some subjects really need to be reinjected with energy from time to time. Last year we had the problem of systematic biology research, for example, greatly neglected, nobody to look after it. Within your mechanism, particularly where you referred to the "Co-ordinating Council on Science, Engineering and Technology", would you like to tell us how you see that kind of body coming to priorities?

(*Dr Mulvey*) You have referred to this co-ordinating committee which we have seen as looking across the boundaries, not only the boundaries within the science base but boundaries with other sectors of Government.

212. So it is not just strictly basic science?

(*Dr Mulvey*) No, one could imagine a structure within which you bring together people who have responsibility for looking at the research councils plus the higher education sector, the science base. From time to time you try and co-ordinate the decisions and policies there with what is happening elsewhere. We do not think the science base should look at its priorities entirely in isolation of what is happening elsewhere because you could get a distorted set of priorities. Within the science base, which will involve the research councils, a body like ACOST will have some views and the ABRC. The research councils themselves in the way they operate, need to look more across the boundaries of their committees to see where things are falling in slots. One experience people have is that if you are trying to pursue a line of research needing support from the research councils and this lies centrally within the definition of one of the committees or sub-committees it is relatively straight forward; what becomes very difficult is as you move towards a margin. I think that is the area where there is particular difficulty in getting funding.

213. Would you not think that is the duty of the ABRC as at present constituted?

[Lord Dainton *contd.*]

(*Dr Mulvey*) Yes.

214. Is it your impression it does that well or otherwise?

(*Dr Mulvey*) I am not aware that it actually does it very well. The problem is—and we have a lot of discussion at the moment in various documents about changing the structure of the research councils—you will always have boundaries simply for logistical reasons. You have to divide things up, whichever way the new councils turn out to be. At least on my understanding of SERC I do not think there is a mechanism which reviews, at least on a yearly basis if not more frequently, what is happening at the boundaries. For example, you mentioned systematic biology, are we losing a whole topic. So I think certainly within something like the present structures there has to be a much more conscious effort, at the boundaries.

Chairman

215. We questioned Sir Mark Richmond about that the other day and he would very much agree with what you have just said. I wonder whether we can change tack a bit. Lord Dean and others have touched on this but how do you compare the way we do things, how we set priorities and carry them out, with how it is done in other comparable countries? Dr Freeman has experience of the United States but there are other countries, such as France, Germany and so on, and Japan perhaps, that we ought to be comparing ourselves with. What are the lessons that can be learnt?

(*Dr Mulvey*) I cannot answer whether we do it better or not. As I think I said a little earlier, we all face the same difficult problems, and in so far as I have looked at what happens in, say, Japan or in France and Germany, I am not aware that I have seen any particularly striking difference which says that they do it better. Perhaps in some respects they do it worse. I am sorry that we are harping on this point but the one thing one does find is illustrated by the experience of one of our colleagues who experiments frequently at the University of Bonn and although the system there is not called dual support the scientists less frequently have to think of applying for a grant in order to make the next step in the experiments. As Dr Freeman has already mentioned, one way or another it is clear that in the States there tends to be much more local freedom for supporting research and initiating it. The only other remark I would make is that, looking at the situation in Germany and also in Japan, and to some extent in the United States there seems to be a more conscious and direct linking between policy setting for science and technology and the overall policy of government than there is here. ACOST and ABRC seem to me to be somewhat distant from the actual decision-making. When you look, for example, at the Cabinet committees there is one called EDS, dealing with science and technology policy. To a first approximation it is the whole Cabinet minus perhaps a handful and it has no external advice at all. This is unlike the situation in the United States and unlike the situation in Japan.

Lord Dean of Beswick

216. Are you saying that the only advice that the Cabinet committee or the committee dealing with this would get would be from its own civil servants?

(*Dr Mulvey*) I should have pointed out that the Chief Scientific Adviser is in attendance at the EDS committee.

Chairman

217. One point that you have been very firm about is the dual support system and your regret that the university side of it has been dwindling. There is something of a paradox here, of course, because it is exactly people like you university people who sit on the committees of the research councils and say, "We want the university side of the dual support system to come to the research councils so that we can spend it more wisely and better than the universities do." It is the same people involved very largely, is it not?

(*Professor Joyner*) Can I comment on that. I think the problem is slightly different. What has happened is that as the dual support system has collapsed, the amount of money people have received from research grants has not been sufficient for them to be able to carry out the research and we have all been accused by our universities, that in receiving research grants, we are asking the university to subsidise our research, because the money does not cover the full cost of research and this choice has been forced upon us, for a completely different reason from that which is perhaps in your mind.

Baroness Perry of Southwark

218. Could we pursue this phrase which has been used several times about the dual support system having "collapsed". I am not quite clear why it is thought to have collapsed. It has reduced in cash terms by about £80 million, in real terms by a little more than that, but it is still there; it is just being very much more selective than it was.

(*Professor Joyner*) The collapse which is being referred to is not specifically the DR transfer; it is the erosion of the real value of the dual support element over time and it is illustrated, I think, very firmly in the figures that Matthew Freeman gave you of what we can provide for young people at the start of their career to do something useful and the amount of money we can provide for people to continue doing something useful. The original assumption when I came into this business 25 years ago was that people only rarely went to research councils for support because they were, broadly speaking, supported through dual support. This is no longer the case. If you do not have a research council grant you are not viable as a research group. This is a historical change, it is not solely related to the DR transfer.

219. I think it is important to distinguish between erosion and collapse because in some ways what is happening with the dual support system is exactly what you are asking for, it has been giving much more to where there is good science rather than where there is no science.

(*Professor Joyner*) If the soil under your house is eroded sufficiently it will collapse.

Lord Dainton

220. The equipment grant disappeared some time ago and that meant that purchasing equimpment fell back on to universities and that is undermining the well found laboratories?

(*Professor Joyner*) Yes.

Lord Butterworth

221. I wonder if I could come now to the general question in a slightly different way. I am not a scientist but for many years I have listened to scientists asking that we should change the rules fundamentally and one of the important things we should do is to have a Minister for Science in the Cabinet. This was pressed for years and especially by scientists all over the country. Now we have got one, the change has occurred, you have actually now got a Minister for Science in the Cabinet. What do you expect him to do in this crucial question of the ordering of priorities?

(*Professor Lamb*) You are quite right that we argued very strongly for that and we think we maybe had a small effect in actually getting a Minister for Science.

(*Dr Mulvey*) First of all, as you have said, it is a very important step but it is not the whole step. Just yesterday I was looking at the responsibilities of the Chancellor of the Duchy of Lancaster and I am sorry I cannot remember them but it is a list 10 items long and at the bottom of the list comes science and technology. By no means do we have a Minister for Science and Technology. Now had we such a Minister what would we expect? Well the prime responsibility I think would be to get the essential importance of science and technology policy taken to a much higher level of notice in the Cabinet and in Government policy and in such a way that one brought coherence to the somewhat distinct activities of the different departments, including DTI.

222. I think we should try to confine this to the science base.

(*Dr Mulvey*) Yes, I know but your question was much broader than the science base.

223. My question is you have a Minister now, now what do you expect him to do in ordering priorities in the science base?

(*Dr Mulvey*) I expect him, first of all, to get good advice from the structures we have been discussing elsewhere.

224. Are the structures good enough? How would you change the structures in order to improve the advice he is getting? Do you expect him eventually to take decisions?

(*Dr Mulvey*) He has to take decisions on the funding of the science base in broad terms and relate that to the rest of the expenditure but I would not expect him alone to make a decision on a particular area of science.

Lord Porter of Luddenham

225. Chairman, we have at this point to ask the last question on our paper which is, do you welcome William Waldegrave's proposal which is that we should do more to identify those technologies and broad areas of research from which the United Kingdom and its economy can derive most benefit. In other words, he is giving his advice on how priorities should be settled and he is essentially saying for their potential for wealth creation which is not at all what you, Professor Lamb, opened with.

(*Professor Joyner*) My Lord Chairman, I think we fear that William Waldegrave's apparent determination to alter the balance of research in the science base towards more applicable science simply betrays a failure to understand the magnitude of Britain's under-investment in industrial R&D. The problem, as we perceive it, is not that there is too little support for industrial science, for relevant science through the science base, but that there is too little research and too little development within industry. You have the figures, which you are undoubtedly well aware of, that the amount which is available for changing this balance represents about 1 per cent of the total Government expenditure on the science base and playing around with that, moving it from 1 per cent to 0.89 per cent is not going to save the country to an enormous extent. I think this perhaps underlies our unwillingness to answer your very pointed questions, because I think it comes down to the feeling we have that small changes in the way in which the priorities are decided at the present time are simply going to produce small changes in outcomes. Amalgamating all the research councils into one is not going to make an enormous amount of difference and changing the structures within which priorities are decided, as they are at the moment, is probably not going to make an enormous amount of difference either.

226. Do you feel that there is scope for doing more to identify technologies which are going to pay off, and do we not do enough to pick the winners?

(*Dr Mulvey*) The picking of winners is said by the Government not to be a good thing for industry. There is a tendency here, which we find strange, which seems to be that they think they can pick winners more easily in the science base. That we find a bit odd. The foresight and picking of winners seems to us essentially an exercise to be done at the interface between the science base and industry, and industry certainly should be playing a major role in foresight to see which technologies or which ideas emerging from the science base are ones that should be developed in industry. Here I think there is a role for Government, as in other countries, to assist in that exercise, together with the people in the science base but also very strongly with industry. There have been initiatives taken. Alvey is one and there are several others and this has worked quite well, I believe, at bringing together people in the science base, some people in industry and government agencies, but it was not followed through. The major failure was in the investment in industry. It is no good spending time picking winners, or whatever the other foresight activity is, if industry is not going to pick them up and run with them. Industry in Japan does do that. It takes a very strong part in the whole exercise of foresight and it has been very successful in that way. That is really where we have to focus our attention. That is where the minister comes in. He has somehow or other to re-organise, re-orient, the Government so that it understands that it is no good just trying to solve problems by manipulating the science base, especially when it is not going to be taken up in

[Lord Porter of Luddenham *contd.*]

industry. That is where the major problem lies, and where government assistance is needed.

Lord Dainton

227. It almost sounds as if the criterion for the science base should be its applicability to industry. Is that what you mean to say?

(*Dr Mulvey*) No. We have said our priority for the science base should be primarily the advance of knowledge. There is an interface between the science base and industry.

228. What goes on at that interface?

(*Dr Mulvey*) There I think one again should have plenty of room for individual initiative, and we have argued that dual support should be seen as part of that and not restricted.

(*Professor Joyner*) We believe this is something that is done better in other countries. John Mulvey has cited Japan. But I think the analogy or the phrase "picking winners" is the wrong one. What we think happens is that, in fact, they pick rather a large number of horses and they back a lot of them and a small number of those come in as winners but a large number come in as also-rans.

229. In 1972 (I think it was) I went out to Japan, at the request of Mombusho and MITI, to talk with them about this very problem, and one very soon discovered that Japan is very misleading from the point of view of the United Kingdom because its whole economic history was one simply after the war of neglecting basic science for many years until it built up its economic position to the point where it could afford it. I am not suggesting that this should be followed here. I am merely pointing out that the historical position is that ourselves and Japan have come to a position which has entirely different historic origins and, therefore, it is very difficult to get the thinking in this country along the lines on which the Japanese did it. They are now changing very much simply because they have enough money to do what they want to do. I would like to come back again, if I may, it is really a terrible problem for us, how on earth can we make, as Snow said, in the dark underground of science in Government, choices a little more reasonably?

Lord Dean of Beswick] The question was raised, I think by Lord Butterworth, of having a Minister and having been pretty close to how Governments work in another place I would say that, without any personal criticism of Mr Waldegrave, you really have not got a Minister. You have a Minister with a very small brief on this subject. Whoever the Minister is it ill-behoves any Minister to pass the buck on how to share the cake out when the cake really is not big enough. That is what the basic argument was about. I do take the point unless you get a Minister in the Cabinet with lots of clout and muscle it will still take a very junior role and that is what we have to live with. Any ideas that the cake will be bigger because there is a Minister now who has a designation with a basket of responsibilities is absolute nonsense. If it was certain other members of the present Cabinet I would take it take more seriously.

Chairman

230. Lord Dean made a statement rather than a question!

(*Professor Lamb*) Problems arise when there is not enough funding and, although we are not allowed to talk about funding, that is why we have all these problems. What we think would be greatly helpful for decision making is to have more interchange of people between the Civil Service, industry and the universities and between the universities. There is very little mobility in this country. People at a very distinguished level like Members of this Select Committee, of course, move into industry and advise them there. It is very difficult for someone of Matthew Freeman's age to go into industry for a bit and come back out again unless he goes as a technician in a molecular biology lab. What we would like to see is more interchange. Young scientists in my Department, for instance, would be very keen to go into the Civil Service for a year or two to see how it works and we could get civil servants into the universities and similarly with industry. We, with Margaret Sharp, have written articles discussing how to get more people into the management structure of British industry. The problem we see in many managements is that there are no people there who actually know about the industry they are managing, they are usually accountants or salesmen. In fact I wrote to the CBI, the Institute of Directors, and others about this and suggested that each quoted company in the United Kingdom have a scientist or engineer on the main board. One reply said somebody suggested to us that we should have a salesman on the Board and that has not made any difference, why should a scientist make any difference? We think the quality of decision making could be improved if there was more interchange so people could understand each other's problems.

Lord Dainton

231. My Lord Chairman, just one question, if I may, over this question of the interrelationship of the universities, where a lot of research is done, and the research councils. Would you be in favour of the Chairman or the Chief Executive of the Higher Education Funding Council, or two of them, being a member of the board of research councils?

(*Professor Lamb*) Yes.

Chairman] Thank you all very much indeed. It has been a very interesting session.

Letter from Save British Science

I enclose a brief memorandum clarifying our position on two of the matters which we feel were left in an unsatisfactory state last Wednesday when we gave evidence before Sub-Committee I.

We realise that in the context of the present enquiry you may still regard these responses as not very helpful. But SBS has its origins in a realisation by many scientists of different disciplines that the degree of underfunding which had developed by the mid '80s was having an increasingly divisive effect within the scientific community, going beyond a naturally strong dedication to one's own field over others and towards a breakdown of a common sense of purpose in the advancement of science.

As opportunities for new science were, at the same time, expanding rapidly in all fields frustration mounted. Ministers earnestly sought advice from supplicants about which other area of research should be cut to provide for their needs. No one was winning except the Treasury. Leadership was lacking, with the Royal Society either too aloof or, probably, as divided as the community. No one appeared to be making the case for science as a whole, and Ministers told some of us that there was no hope of change unless public interest in the needs of science was raised.

The situation is not much improved, although the House of Lords Select Committee has produced some outstandingly good reports and the Royal Society has been rather more ready to speak out under its Presidents of recent years.

SBS has always made it clear to its members and others that it is not in the business of saying which areas of science should next be sacrificed for the benefit of others. What is needed is more people, more scientists, making the positive case for adequate investment in science as a whole.

J H Mulvey

26 April 1993

In this memorandum we wish to clarify our answers to two important questions asked during the giving of oral evidence on 21 April 1993.

Q1. *How should priorities for the science base be set, in particular should the present system be changed?*

A. In parallel with the setting of priorities through the ABRC/Research Council system it is in our view essential for the vitality of the science base that there is:

(1) Devolution of responsibility for choice wherever possible to the individual researcher. In the universities this requires restoration of an effective, adequately funded, dual support mechanism. This approach would help to seed original research, to sustain unfashionable areas of research, and also to give opportunities to younger scientists.

(2) Maximum plurality of funding sources and mechanisms.

(3) Support of individual excellence.

(4) Greater recognition of the *training function* of the science base.

Our prime concern is to return to more "bottom up" setting of priorities, and hence our insistence on the importance of dual support. We are not convinced that structural changes, at the Research Council level, will bring any major benefits. These mechanisms are probably as good as those of most countries. The problem is lack of money causing—as the ABRC has said—too great a narrowing of the research base.

Q2. *What should be the priorities for the science base, assuming no increase in funding?*

A. SBS believes that *increased financial support* is the first priority, to enable the science base to exploit fully today's opportunities and increase its ability to contribute to national wealth. SBS speaks for the science base as a whole, and does not enter the discussion of relative priorities. All sectors of research are seriously underfunded.

We argue that the way to a more competitive, wealth creating industry is through a vigorous expansion of the industrial research base, and not by concentrating more SERC funds on research of supposed relevance to industry. In the absence of the former, the latter would be doubly futile.

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HOUSE OF LORDS SESSION 1992-93

MINUTES OF EVIDENCE
TAKEN BEFORE

THE SELECT COMMITTEE ON SCIENCE AND TECHNOLOGY

SUB-COMMITTEE I PRIORITIES FOR THE SCIENCE BASE

Wednesday 28 April 1993

HIGHER EDUCATION FUNDING COUNCIL FOR ENGLAND

Professor Graeme Davies and Mr Bahram Bekhradnia

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WEDNESDAY 28 APRIL 1993

Present:

Butterworth, L.
Chorley, L.
Dainton, L.
Flowers, L. (Chairman)
Perry of Southwark, B.
Porter of Luddenham, L.
Selborne, E.
Tombs, L.

Memorandum by the Higher Education Funding Council for England (HEFCE)

HEFCE PRIORITIES

1. *What is your funding method, with particular reference to research related factors?*

1.1 The Council distributes recurrent funding for Teaching (T) and Research (R) through largely formula-driven methods and, in addition, allocates Non-Formula Funding (NFF) for special purposes. For 1993-94, the first year for which the HEFCE is fully responsible for funding higher education institutions (HEIs) in England, the division of allocation is:

T £1,565.1 million (62.0 per cent) R £618.0 million (24.5 per cent) NFF £342.8 million (13.5 per cent)

Of these sums £729 million went for teaching in science and technology subjects and £419 million for research.

1.2 The Council distributes the funds available for research under three broad headings according to the formula

$$R = QR + CR + DevR$$

where

QR reflects the quality and volume of research

CR encourages institutions to undertake contract research on a full-cost recovery basis

DevR encourages the development of research potential in selected areas

1.3 **Quality-related funds (QR)** 94.7 per cent of the R funding available was distributed based on quality ratings and the volume of research conducted in the institutions. A small part of the QR funding was allocated for applied research. The measure of quality resulted from the Research Assessment Exercise (RAE) conducted by the Universities Funding Council (UFC).

The basic QR distribution was based upon the relationship

$$QR \text{ is proportional to } Q^*(RAAS + N1^*w1 + N2^*w2 + N3^*w3)$$

- Q is a quality rating derived from the ratings from the Research Assessment Exercise
- RAAS is the number of Research Active Academic Staff supported on general University/College funds
- N1 is the number of Research Assistants and w1 their weighting
- N2 is the number of Research Students and w2 their weighting
- N3 is the number of Charity-funded Equivalent Academic Staff and w3 their weighting.

Quality, in the RAE, was measured on a scale of one to five but was reduced to a scale of nought to four for purposes of funding. The total QR sum was first distributed between 72 areas of research activity that correspond with the 72 Units of Assessment used in the RAE. The distribution reflected the historical provision to the institutions in these areas. The historical pattern was set by the UFC which in turn based its model of research funding on its estimates of research expenditure by the institutions. A small adjustment was made on account of research expenditure in the new PCFC institutions.

1.4 **Contract research related funds (CR)** 3.3 per cent of the R funding available was distributed pro rata to institutional income from contract research other than from the Research Councils, Charitable Trusts and Funding Councils as well as pro rata to the estimated overhead recovery rate on these contracts. The intention of the Council is twofold. Firstly it wishes to encourage institutions to earn more from contract research and secondly to ensure that proper recovery rates are charged.

1.5 **Development research (DevR)** Following the unification of higher education the Council felt that the institutions coming in fresh to research funding were at a relative disadvantage to the older institutions who had had the opportunity over a number of years of building up an infrastructure for the conduct of research. The Council also considered that by making an allowance for development in the new institutions the possibility of ossification of research solely in the older established universities would be avoided. 2 per cent of the total amount available for research was distributed as DevR. This DevR money was made available to the institutions new to research pro rata to the number of research staff in Units of Assessment with a quality rating of two and above. Although amounts have been allocated to institutions according to formula, the HEFCE requires strategic plans for the expenditure of these funds. It is to be understood that after a period of about three years the Council will wish to review the gains made by the introduction of this element of funding at which stage it is likely to be phased out.

1.6 The council also intends to distribute a part of its equipment grant based on research based criteria.

2. *What are your objectives and priorities, as regards university research? How are they reflected in your funding method? Are they different from those of the other Funding Councils?*

2.1 The Council has, in its first year, in the main relied on the existing pattern of spending on research in the universities in allocating funds to subject areas. The Council has felt that it cannot be too prescriptive about areas of research work. The Council has ensured that the balance between spending on research in medicine, science and engineering on the one hand and the non-sciences on the other did not change to the detriment of medicine, science and engineering. With the inclusion of the institutions new to research funding, the volume elements in the non-science areas have seen larger increases relative to medicine, science and engineering. The Council's funding method ensured that funds did not leave the medicine, science and engineering areas to pay for this extra volume of research in the non-science areas.

2.2 The Council is also actively pursuing with the institutions the establishment of systems of accountability which make more explicit the way the Council's funds allocated for research are used.

2.3 The Council feels that institutions should involve themselves more in obtaining research contracts from private organisations and EC government. Also in so doing the Council expects the institutions to charge a "proper rate for the job". Its funding of the CR element was designed to encourage these activities. The more that an institution earns from such research and the more effectively it can account for its earnings the greater is its share of CR funds.

2.4 The Council's policy for distribution of funds rewards quality highly selectively.

2.5 The Council believes that the possible introduction of new blood, in terms of research workers from the non-UFC sector, could prove to be good for research in the country. The DevR element of the funding is to help with the possible existing infrastructural problems within these new institutions.

2.6 The Council's funding methodology does not reward near-market research but makes available a small amount of funding in recognition of applied research activity.

2.7 The HEFCE has less of a local dimension in funding research than the Higher Education Funding Council for Wales (HEFCW) and the Scottish Higher Education Funding Council (SHEFC). Although broadly all three funding methodologies agree, local needs are more easily identifiable in Scotland and Wales than in England and this has been reflected in slightly different distributions between the 72 funding areas. Additionally, in order to recognise regional priorities, the SHEFC and the HEFCW used different Q scales to that used by the HEFCE.

3. *To what extent do you have your own "scientific agenda"? That is, is it part of your function actively to defend particular scientific activities, and do you take into account the impact of your decisions on the pattern of scientific research in your region?*

3.1 The money we allocate for research is in the nature of a block grant. Institutions are free to use these funds in the way their management consider appropriate within the constraints of accountability. Unproductive use of funds will lead to a lowering of quality, which in turn, in accordance with our funding method, will result in the reduction of funding.

3.2 The Council believes that reliance on the judgement of the institutions adds to the strength of the operation of the dual support system.

3.3 The nature of scientific research funded by the Council in the universities is such that it is difficult to measure the immediate effects of such research.

4. *Does your funding method leave you with areas of discretion or flexibility? If so, what objectives and priorities inform your decisions in those areas? What information do you use as a basis for such discretionary decisions?*

4.1 The Council's aim is to preserve continuity over reasonable periods of time. It does not wish to be overtly interventionist and with that in mind the method of funding was developed in consultation with institutions. The relative amounts allocated for QR, CR and DevR were arrived at after a period of discussion with institutions. The Council listened to the arguments but made its own judgement taking into account the totality of all the arguments. The Council is also able to take into account external priorities when these are articulated eg through the forthcoming OST White Paper on Science and Technology. It expects to revisit the distribution of funding to the 72 subject areas of allocation during the coming year.

5. *Are your priorities free-standing or are they linked to the priorities of any other funder of the science base in your region? What account do you take of the priorities of Government departments other than DFE, or of industry and commerce? Do you feel that implementation of your priorities is obstructed by any other funder of the science base in your region?*

5.1 The Council's priorities are free standing but within them space is found to take into account the actions of other funders. The officers meet regularly with officers of ABRC, the Research Councils, the DTI and the Department of Health and the Council is represented on ACOST, the SERC, the NERC, the MRC and the ESRC. The Chairman of the ABRC is a member of the Council. Through all these avenues the Council is kept aware of current developments and outside priorities.

5.2 Funding from Charities, mostly the Medical Charities, receives special treatment in the R funding allocation process. In making funds available to subject areas the Council also takes into account the recent transfer of funds to the Science Vote.

6. *What contact do you have, or need, with ABRC or with individual Research Councils?*

6.1 As described above Council officers meet regularly with officers of ABRC, the Reserch Councils, the DTI and the Department of Health and the Council is represented on ACOST, the SERC, the NERC, the MRC and the ESRC. The Chairman of the ABRC is a member of the Council.

7. *In practice, how much of the running in your decision-making processes is made by your members, and how much by your permanent staff or by consultants?*

7.1 There has been a healthy interaction between members of the Council and our permanent staff in the development of the research methodology. The Chief Executive has a Research Advisory Group largely composed of HEFCE and ex-UFC council members. The R funding methodology in its final state is owned by the Council and hence debates in Council consider proposals and alternatives very carefully. Consultants have been used sparingly and only when a particular need has arisen eg to take forward a review of possible approaches to accountability for research funding. When used consultants are steered by committees with participation from Council members. Sub-sets of Council members have always been consulted in depth before any major points are tabled in front of the entire Council. The permanent staff have a major role in the initial stages of planning of the work.

University Priorities

8. *To what extent do you encourage universities to set and follow priorities in using the money you provide? Do you (a) steer and (b) monitor what each university does with its block grant? Could your objectives and priorities be frustrated by decisions made at that level, and if this happened how would you respond?*

8.1 It must be emphasised that the Council's actions are fully consistent with the maintenance of the "Block Grant" principle and the bulk of funding allocations must be seen in that context. The intention is not to earmark or indicate particular elements of grant other than in exceptional and clearly defined circumstances. While it is natural that the increasing use of devolved budgetary procedures within institutions should involve models which mimic the Funding Council's procedures to a greater or lesser degree it is not expected that the outcomes of the Council's procedures should be interpreted over-rigidly. This attitude is fully consistent with the principles of accountability for the use of funding allocated for teaching and allocated for research. The important point is that institutions should have strategies for the use of their income which support their missions and that they should be able to account against those strategies.

8.2 The Council has a set of regional officers who are assigned to specific universities and who know about how Council funds are utilised within each of their institutions. These regional officers, led by very senior officers (sometimes by the Chief Executive), meet with the universities on a regular basis to discuss their problems and progress. Relevant information is fed back to the Council. Specific problems affecting research can be and are raised through this channel.

8.3 The Council's relationships with institutions are not confrontational. In the event of difficulties with institutions, for example with institutions which need to be safety-netted, we arrive at agreements as to what we expect from our funding. The Council also has responsibility to monitor the financial health of institutions and through this activity it is kept aware of the overall patterns of expenditure within institutions and, as necessary, can intervene.

9. *What are your expectations for scientific research in the new universities in your region?*

9.1 The Council's expectations from the new universities are no different in essence from the older universities. it is believed that they will bring new blood into research thus helping to prevent ossification. However, the Council does not expect to see any significant shift in the missions of the new universities defined in terms of the volume and nature of the research work they undertake. But if these new institutions can competitively earn more research money then the Council sees no reason for constraining them.

10. *Do you intend or envisage that the universities in your region will move towards an R-T-X model or something like it?*

10.1 The nature of the institutions entering the new integrated higher education sector and the strongly selective processes for allocating R funds will be reflected in a continuum with the exceptionally research strong universities at one end and the teaching-dominated institutions at the other end. Within that continuum there will be institutions with differing relative strengths in research and teaching but the Council will seek to ensure that the continuum is not static and that institutions can move relatively within the continuum.

10.2 With the explicit nature of our funding for T and R and the emphasis on the linkage of money to high quality research, institutions may decide on mixed strategies defined by the proportion of research and teaching they are willing to undertake. Future developments will depend very much on what institutions can deliver in the way of student numbers and quality of research. With greater emphasis on accountability, institutions will need to formulate appropriate strategies. The Government is only likely to increase funding in line with (expected) increases in student numbers (after accounting for efficiency gains) but apart from inflationary adjustment the research quantum is unlikely to see any large increases.

10.3 Further, since the selectivity in R funding operates at a Unit of Assessment level, it is quite feasible for an institution to achieve excellence across only a narrow subject base and thus, to have a high R region in a predominantly T arena.

GENERAL

11. *Are you involved in the arguments about indirect costs of research following the dual support transfer? Do you consider that the transfer was a good idea?*

11.1 The Council officers have been involved in discussions with institutions and with Research Council officers. The Council's role has been that of mediator/observer. However, the Council is concerned that the consequences of the transfer should not be damaging to HEIs and that the commitment by the Research Councils to ensuring that the transferred funding is fully returned to HEIs is met. The Council has taken into account the transfer in its R funding allocation procedures which assume full reimbursement to HEIs.

11.2 As Chief Executive I believe that the decision to make the transfer was based on a misunderstanding of the funding methodology of the UFC. An element (DR) of the UFC's R funding allocation was misinterpreted as the provision of "overheads" for research work from the Research Councils whereas the UFC had merely utilised the peer-reviewed judgement of the Research Councils to distribute a proportion of its research funds. Considerably more money was transferred to the Research Councils on the "overheads" assumption than was distributed by the UFC through DR.

11.3 Current events indicate that the most research-strong universities (eg Cambridge, Oxford, UCL, Warwick, Imperial College) have experienced funding shortfalls as a consequence of the transfer which have caused substantial short-term difficulties. Only if the commitment referred to above is fulfilled will there be no longer term effects. Further, there is some evidence that one of the consequences of the transfer is that institutions are more constrained in their ability to exercise flexibility in research and in being able to guarantee stability in funding.

12. *Why are you funding unversity research at all? What would be the consequence of transferring full responsibility for funding university research to OST/ABRC/the Research Councils?*

12.1 HEIs are collectively the major national providers of research across all fields of activity. The research they undertake covers a very wide spectrum; it includes basic research into fundamental new areas of knowledge, strategic research aimed at focusing the outcomes of basic research onto particular problems or areas of interest, and mission-oriented work, which is often contract-based, aimed at a particular customer or application. This work is undertaken by a combination of full-time research staff, others who carry out both teaching and research, and by research students who work closely with their academic supervisors or with industrial and commercial sponsors while studying for a research degree. This highlights the importance of another role of the HEIs as producers of highly qualified manpower, whose advanced training and research expertise meets the needs of many sectors of the economy and helps promote the UK's international competitiveness.

12.2 Funding for carrying out this research and providing research training is received by HEIs from a range of sources. Grant provided by the Funding Councils is usually the largest single element. The research-related allocation provided by the HEFCE has a number of principal purposes:

- it covers almost all the costs of the basic research undertaken by HEIs, which forms the foundation for strategic and applied work, much of which is supported by other Government funds and by charities and industrial and commercial organisations
- it provides the stability of funding for research which enables HEIs to establish the long term strategies essential for the attainment of excellence
- it allows for the identification and pursuit of new areas of research in advance of their support from Research Councils and other funding sources
- under the dual support system, it covers a proportion of the costs associated with projects otherwise funded by the Research Councils; the new arrangements for dual support introduced following the 1991 White Paper mean that HEFCE funds will provide for the costs of permanent academic staff and premises required for such projects
- it contributes to some of the infrastructure costs of training research students
- it provides resources which allow for the support of new and young entrants to the academic community while they are establishing their research credentials.

12.3 It is the Council's firm view (and a view shared amongst others by the Royal Society, the Royal Academy of Engineering and the CVCP) that further transfer would jeopardise the above purposes to the serious detriment of the universities and colleges.

13. *How have the universities in your region benefitted so far (or how can they expect to benefit) from access to their own Funding Council?*

13.1 There is a long history of universities benefitting from the research support from the UFC and the UGC and it is confidently expected that the HEFCE funding for research will yield similar benefits. As yet it is too early for particular areas of regional benefit to be determined since the Council's first full funding year begins in August 1993. However, the interactions between the Council and the HEIs will seek to ensure that there is full awareness on both sides of needs and expectations and that this awareness will lead to institutional benefits in research.

27 April 1993

Examination of witnesses

Professor Graeme Davies, Chief Executive and Mr Bahram Bekhradnia, Director of Policy, of the Higher Education Funding Council for England, were called in and examined.

Chairman

231. Professor Davies, Mr Bekhradnia, thank you very much for joining us.

(*Professor Davies*) Thank you.

232. Professor Davies, do you want to make any opening remarks, or shall we charge straight on?

(*Professor Davies*) No, I would be quite happy to charge straight in.

233. We are talking about the formation of priorities for the science base and you will understand we are not trying to invent priorities ourselves. We are trying to study how it happens and whether the process can be improved and in particular we are not talking about how much money is involved in total. Within that context of policy formation, is the Funding Council still of any importance at all?

(*Professor Davies*) We would certainly argue that the information that we have gleaned from the sector over a number of years and the basis of our own funding methodologies are such that they provide, for the universities, two particular forms of support, which seem to attract considerable approval from the sector as a whole. They provide the institution with flexibility, which allows the institution to do a variety of things to develop their research, so that they can build upon new strengths, they can bring on new people and operate in that flexible way. The other thing we do is we provide them with the long term stability through this base element of our contribution to the dual funding stream, which allows them to take a perspective which perhaps reflects their own skills and abilities and priorities, as much as it reflects some of the priorities that come to them through other funding bodies, such as the Research Councils; but we would emphasise, I think, the combination of flexibility and stability as being a very important part of the way in which the Funding Councils can fund.

234. Then apart from the total amount of money you put out nominally for research, you are acting merely as a mirror to those who do form policies, rather than being policy formers yourselves, are you not?

(*Professor Davies*) I think there is some truth in that, in the sense that the Council, as a Council, has been very reluctant, for instance, to drive too directly the activities of institutions, other than where it has external evidence which would push it in a given direction. It has seen itself much more concerned with seeking to support excellence, where it exists, and therefore to set up funding structures that send the funding stream towards those institutions who

[Chairman *contd.*]

have particular centres of strength. So in a sense, our priority as such, is to operate within the framework of the high level of selectivity, thereby underpinning the very good work that is going on (where it is going on) which in turn allows them to seek to support the priorities that perhaps the Research Councils or the Department of Trade and Industry or the Department of Health may be bringing forward.

Lord Dainton

235. I look at this formula (1.3) and I see quality of research and that is the basis upon which you will allocate more funds, if in fact research in a particular area is strong, judged by quality. That seems to be an evenly directional force. In other words, those that have and are good, get more. How do you cope with the situation where there is a necessary field of activity, which you want to see developed in the universities, but where there is no strength, as for example, applied physics in technological universities? You do refer a little later on in your memorandum to something called "Developmental Funding", I think. Is that meant to cope with that problem?

(*Professor Davies*) Well, Lord Dainton, there are two aspects to this. The first is that although we have a funding methodology which is based upon individual measures of excellence at a unit of assessment level—where a unit of assessment in old-fashioned terms is a subject level, so that a unit of assessment may be, for example, chemistry—this is methodology that allows us to build up a grant. We inform the institutions of the way in which the grant is built up, but we do emphasise to the institutions that within the framework of accountability for their spend, it is *de facto* a block grant, which they can then exercise their own priorities within and we know that a great many institutions chose quite deliberately, for instance, to take a proportion of their R allocation and put it aside for developmental purposes.

Lord Chorley

236. Within the subject area?

(*Professor Davies*) Not necessarily. Across subject areas.

Lord Dainton

237. They can correct?

(*Professor Davies*) They can make adjustments, indeed. In fact I am at pains to point out to institutions that the money, although we identify how the grant is constructed, is not in any way earmarked or predicated. They must exercise their own priorities, so that for instance, they can bring on new areas. The other question you asked about Development R is a very small amount of funding and in terms of the totality of funding we have, it is some £12.5 million in £600 million worth of R spend, which was created this year particularly to help the new universities, who come into the unified sector, perhaps to develop their research base, so that in some areas they can parallel the position of the existing universities who have been in receipt of R funding (research funding) for a very long period of time. The Council, in doing that, has essentially made two important qualifications. One of them is that this is likely to be funding which has a finite lifetime and we suspect that although the Council has not resolved this yet, it will only run as far as the next research assessment exercise. Secondly, we require of institutions that they come back to us with a strategic plan for the use of that money, so that they do not, for instance, simply spread it like jam across their institution; but they look for where their own strengths and priorities are and seek to deploy this development research funding accordingly. So there are two aspects of it. There is the block grant aspect, which applies to all institutions and there is the special Development R money, for which the only eligible institutions were those which were former polytechnics and colleges.

238. Would it be right to say that at the moment you really have the minimum amount of money which you can deploy in those two ways and any further transfer to the Research Council sector would seriously handicap your policies?

(*Professor Davies*) My view—and I believe my Council's view—would be yes, that we have difficulties. We have noticed that, for instance, in the allocations for this year there has been, as a consequence of the research assessment exercise, what often is called "grade drift". Because of the existence of the research assessment exercise, institutions seek to manage their research in a more direct way. Then there has been an increase in the average grading, particularly in the old universities. It moved up by about a half a point in five. The effect of this has been that a grade five department in fact attracts a little less funding per unit of skill, if one could call it that, than perhaps it would have from the last exercise. This is an issue which the Council recognises and will need to address, but constraints on the amount of funding available makes it more difficult to address that.

Chairman

239. One of our concerns is that perhaps the system as operated by the Research Councils is getting too directed, that there is not enough flexibility or freedom to choose unpopular or new things. You yourselves, by reflecting the successes of that system, have put universities in a position when it is really only a very brave Vice-Chancellor who will say, "This money that I have been given, I intend to slant some of it away from those departments or activities which attract money towards those which we think should be developed and ought to be developed"?

(*Professor Davies*) With respect, my observation of the current class of Vice-Chancellors is that they are very active managers and recognise that the added information that we give them makes management more difficult but they are seeking to have developments because they recognise that if you do not have a commitment towards long-term development you rather devalue your own research currency quite quickly.

240. Could we discuss for a moment what the consequences might be if still more research money is taken away from you. The Research Councils make

[Chairman *contd.*]

no bones of the fact that they would like to take the lot.

(*Professor Davies*) Our view is that a great deal of the work that goes into those other forms of research-related activities other than those which are project-directed would suffer to the detriment of both the sector and the national interest as a whole. Let me pick up three aspects of that. One of them is the very important role that our research funding plays in seeking to support manpower developments. There is direct funding that comes from the Research Councils which will support some graduate students, but there is no doubt that the general level of support, for instance, through the research training support grant is really quite risibly low. The funding that comes from the Funding Council does provide a great deal of the infrastructural background that is necessary for the growth of sound and very effective research unit activities. Secondly, it allows institutions, particularly with appointments of young research-active staff, to encourage them to develop their talents at almost a pre-Research Council stage, so that they can get into that, which is, I think, another important activity. Thirdly, it allows them to identify areas of activity in which they may not have a strong presence but where they can see in a longer-term horizon they should have a presence and, therefore, can devote resources with the view to being in a very sound position in three, four or five years, whereas frequently the project-related activities of the Research Councils do not allow them to do that.

241. That is a very important part of the infrastructure and I would be the last to try to belittle it, but may I come back to the question I asked before. When it comes to the setting of major priorities for some branch of engineering that is a matter of national importance to be developed, or whatever it may be, do you any more play an important role or is it played by the Research Councils and government departments and so on and you are merely reflecting those priorities rather than taking the lead in setting them yourselves?

(*Professor Davies*) The latter would be true. In the main we reflect broad changes in priority. The funding methodology is based to some extent upon the practices within institutions themselves, and by looking at the balance between, say, science and technology and other disciplines. It has been the Council's practice to date not to make major shifts in funding between disciplines. In the review of the way in which the funding stream breaks up on a discipline basis, I would expect to see the Council make only minor shifts in the priority judgments.

Lord Dainton

242. In this connection, do you, in fact, keep a strategic eye on the developments in particular subjects? Just to give you one example, systematic biology research, which has been the subject of an investigation by this Committee, there we found something had slipped away entirely within ten years really rather desperately badly. It was not there just when it was needed. Is there any mechanism for doing that? We did not seem to find one within the Research Councils and one begins to ask a second question: what influence can you bring to bear or what knowledge can you contribute to the discussions of a body such as the ABRC which would make them better informed about the universities? Are you a member?

(*Professor Davies*) No.

243. Would you like to be a member?

(*Professor Davies*) I have expressed the view that it would be very helpful and from time to time Sir David Phillips has invited me to attend the ABRC. I have regular meetings with him, not only in his role as a member of my Council but in his role as Chairman of the ABRC, and that is a very positive way for us exchanging information about priorities. But to pick up your specific issue, we would, I think, feel that it is largely within the expertise within the institutions that knowledge lies of the needs in a particular subject area. We would seek to be supportive of that and we would expect institutions' strategies to be able to be interpreted in a flexible enough way for them to divert our funds, which is why they are not earmarked.

244. This is precisely why I chose this example because they were responding to the fashions within the Research Councils which led to this particular disastrous situation. Somebody really ought to be monitoring this kind of thing, ought they not?

(*Professor Davies*) We do not fulfil that role. We have only in the main acted in these particular areas in a supportive way, so that, for instance, in the responses we had from a variety of sources about elements of the infrastructure that we do not currently support, like collections, then we would seek to provide support when a shortfall in support is drawn to our attention. That in a sense highlights another issue which is related to the balance between a block grant principle and a project-based principle, that it is often very difficult to obtain project-based support for what are seen to be central facilities of one form or another, and in particular, to give an example, collections like botanical or taxonomical collections fall into that category. We would see that as being a very important role of the Funding Council and of the stream of dual funding that we present.

245. If the dual funding system is to work well, the interdigitation at least from the point of view of flow of information and contribution to discussion between the HEFC and the ABRC ought really to be very strong, ought it not?

(*Professor Davies*) Indeed it should. If I may say so, in my experience it has certainly been an advantage to have had Sir David Phillips on the new Funding Council. I cannot believe it would be other than an advantage if a reverse relationship existed.

Lord Chorley

246. You say in your submission that you believe very strongly in plurality and I am certainly for that, but if you are just reflecting the status quo you are not really contributing much to plurality?

(*Professor Davies*) My Lord Chairman, I think that would be true if our funding carried with it labels which said, "This allocation is for *this* purpose." It does not and it is seen to be quite fundamental that it should not because if it did have labelling, then our

[Lord Chorley *contd.*]

argument in favour of plurality would quite definitely fall.

247. I am not sure that it would, in my book, because you might take a different view. For instance, if you take Lord Dainton's point, you might take the view that the Research Councils are missing out on this and perhaps we should be putting some effort in, some money into it?

(*Professor Davies*) I suppose in a sense we are. I would choose an example of a discipline such as the high-temperature superconductors. There was an area where the sector was able to move very quickly and redeploy its own resources from within our flexible dual funding stream before the Research Councils could themselves respond to create an initiative which would be supportive. I think that my experience, both prior to taking up this post and since being in this post, is that in the main the universities are always on the lookout for ways in which they should best position themselves for the most important research activities and for the most critical ones.

248. I certainly understand what you say but it seems to me not really quite what I thought of as plurality but there we are. What about basic versus strategic versus development-type research? Again do you really take no particular view or do you reflect the way Government shifts policy?

(*Professor Davies*) We were constrained, in a sense, by the guidance that we received from the Secretary of State about where we should deploy our research funding, to ensure we did not operate—to use the phrase—too near the market in terms of providing support which could perhaps be interpreted as being a subsidy for industry. On the other hand, we recognised that institutions and academics within those institutions do not perhaps see as clearly the difference between basic, strategic and applied research as for instance the Frascati definitions or some of the interpretations outside the academic community might indicate. A very good example of this might be in the research assessment exercise. We made provisions in a number of disciplines for the assessment of basic research and applied research separately. The engineering disciplines came back to us and said: "We do not wish to make a distinction, because as far as we are concerned, it is a continuum and you cannot differentiate between the two." You might, for instance, argue that research on ship hull structures is as much about understanding the basic physics of boundary layer behaviour as it is about designing a better and faster boat. So they declined to make that division. Others did not at this stage. Our advice to our own Council as a consequence of reviewing the outcomes of the research assessment exercise is, this was an artificial distinction which it would be in the best interests of the sector to abandon. I also believe that the messages that we are now picking up from Government, lead the Council to move away from the very serious constraints it had about operating in the near market area.

Baroness Perry of Southwark

249. Professor Davies, I wanted to return really to the message which lies within your methodology, so to speak. I think that all of us within the university sector appreciate the increasing degree of flexibility and the way the funds are given and the less they are tied in any sense to different kinds of research or different subjects in the way in which they are, I think the happier we all are. I also agree with what you said about modern Vice-Chancellors being perfectly willing to deal with the internal politics of redirecting funds, even though methodology shows from where they were derived. Where I think the constraints still lie nevertheless, are because the methodology itself leads us internally to put money in a heaped-up way, where in three years time—which is a very short space of time in terms of research areas—we shall be successful again and continue to keep the funding stream going and indeed increasing. The danger of that is of course that where you might for different reasons believe that it was important to keep a particular subject area alive in research, the judgment could very well be: "Well they have only got one this time. In three years time they are not going to do more than one and a half. Is it really worth putting money there?" That, in a sense, determines an almost frozen kind of structure, with the very rare exceptions of the kind of thing you mentioned, the high temperature superconductor activity, where people know the money is going to come from other directions and you can position yourselves to make a bid; but I do think there is a real danger that the methodology now, for very good reasons—I think the methodology on the whole is almost entirely healthy—is going to freeze the system so to speak as it stands. Could you comment on that?

(*Professor Davies*) Baroness, my comment would be that although there are 72 streams within the units of assessment structure and that may appear to be very narrow, they are fairly generic. One would not wish to, for instance, stream chemistry. We may take a simple view that said we would divide chemistry up into physical and organic and stream it. Then I do believe that we would be reinforcing the sort of dangers that you have just identified. So that by at least keeping broad categories, we allow quite a degree of manoeuvre within those broad categories. The other aspect of dangers in the methodology, perhaps if I could take that forward a little further, which we have been deeply concerned about, is that we might inadvertently create or reinforce a form of "publish or perish" syndrome and be interpreted in the sector as believing that volume is more important than quality. Certainly it is very clear from the responses we have had after the completion of the last exercise, which will inform the methodology, that if that is the message that is being perceived externally, then we must seek to remove it and emphasise the quality aspect rather than the quantity. People have said to us: "Do you just, for instance, count up the numbers of publications, or are you interested in the quality and the positioning of the particular publications that are seen as the research output?" We would argue that our methodology should reflect the latter, the quality and position, rather than the former, simply the volume.

[Baroness Perry of Southwark *contd.*]

250. The more you do that, of course, the more you get away from straight quantitative judgments, the more you lay yourself open to challenge?

(*Professor Davies*) Yes, indeed.

Lord Porter of Luddenham

251. I have two questions really. The first is just asking for an affirmation. Some of the questions seem to have been persuading you to say that you have alternative research priorities to the Research Councils, but otherwise you are just jumping on their back and continuing. I hope you will not take too much notice of that encouragement. Many of us are very heartened by the fact that these priorities are indeed left to the individual scientists and I think that is what you are saying, that the plurality really in your case is first of all the Research Councils and then the individual research workers in the universities, overseen, so to speak, by the Vice-Chancellor and so on. It is not a plurality of policies which stems from the HEFCE. Would that be an interpretation?

(*Professor Davies*) Indeed, we as a Council are not equipped to make what I would call the fine, specific judgments in areas of science and technology that a Research Council with its running peer involvement is able to do and we would indeed be redundant if we simply duplicated what they do.

252. Thank you. That is what I understood and I am glad to hear it. That does lead to a small problem, does it not, in that the Research Councils, in trying to justify their desire to grab your money so to speak, to get it transferred to them, one of the things they said (I do not know whether they are still saying it) in the past, was that one of the reasons for this is that money does not really always go to research? So I wanted to ask you, you have this wonderful flexibility; you do leave it to the scientists themselves, who are the best people to judge it, but how do you know from the lump sum point of view of the university, with all this flexibility, that it is actually spent on research?

(*Professor Davies*) Lord Porter, I think in the past there was little doubt that we knew very little about it once it went through the door. The first move in the direction of increasing accountability was to emphasise to institutions that within the block grant streams of T and R, T money was for teaching and R money was for research. This does not mean that there cannot be transfers between them, but they have to be justifiable transfers, which reflect strategies.

Lord Dainton

253. Justifiable to whom?

(*Professor Davies*) Justifiable to the Funding Council. If you would like me to develop that, I can give you what is a common example I use, relating to Taught Masters programmes that currently fall into the T funding stream. If an institution were to take some R money and say: "I wish to support specific Taught Masters programmes in order to guarantee a good supply of young (and not so young) people for my research school", then that would be a very sound strategy, where R money was used in a T mode to sustain R. I think that is really quite a critical point. To come back to the question of accountability, we have been vexed by this and we have of course been prone on a number of occasions to the criticism, of which I am sure your Lordships are all aware, that the university stream of money through the Funding Council goes into a black hole. To that end, we did commission and have recently published a report on accountability for research and we have at the moment a consultative document seeking, within the sector, to agree a sound methodology for accounting for their spend. We do not wish it to be a detailed audit process which is driven by the numerics of accountancy but it should be that there are strategic and operational processes which show that institutions use their R money for R purposes within the constraints that I mentioned.

Lord Flowers] So the black hole is going to turn into a white dwarf!

Lord Porter of Luddenham

254. So you do feel that the case sometimes made by the Research Councils is no longer justified anyway, that the money for research actually is spent on research?

(*Professor Davies*) I do.

Lord Tombs

255. I wanted to take up, first of all, my Lord Chairman, the written response we got from the HEFCE, a very helpful one. At the end of paragraph 7(a) there is a reference to the ability of the Council to take an overall view of the institution, and I wondered if we could have some example of where that overall view leads, what sort of influence is brought to bear, if any? I am encouraged by the sort of loose rein philosophy but I would like to feel there is some general beneficial influence applied by the Council. That leads on, if I may, to a second question, which is the overall strategy of the universities, that is, the multiple institution situation which Lord Dainton has touched on with his systematic biology example. In the past we have had initiatives by the predecessors of the HEFC in geology, in community health, Japanese studies, new blood appointments. Where would such initiatives come from now? Do you take an overall view of the multiple institutions or do you take what I might loosely call a market philosophy, that if we give block grants the market will sort it out?

(*Professor Davies*) No. In some areas we do believe we should have an overall view and we should take up a strategic position where we believe that the institutions left singly would not, in crude terms, get their act together sufficiently to solve what is seen to be a general problem. An example of that might be our activities in the area of reviewing the provision of overall library resources, which is important in terms of sustaining the infrastructure.

256. But that is structural rather than subject?

(*Professor Davies*) Yes. On a specific subject level we tend in the main not now to be pursuing the subject review policy of our predecessor committee and council to the same depth. There are some areas where we do see that we must have what would be called a top-slicing philosophy to help the sector, but

[Lord Tombs *contd.*]

these are in the main infrastructural. For instance, the emphasis in our Information Systems Committee on Super-JANET, the successor to the Joint Academic Network, would be seen as something for which we carry responsibility. We are, of course, still sustaining through our non-formula funding support for minority disciplines, disciplines that could not sustain themselves simply through their teaching funding alone, and this has been particularly important in a number of areas.

Lord Dainton

257. May I come in with a supplementary here? Do you not take a strategic view on some issues in particular subjects? Take, for example, medicine. It may well be that if the Government were to implement the Tomlinson report that would have implications for the intake of medical students into the universities rather than undergraduate teaching schools. Who would determine that nowadays? Who would have discussions with the Department of Health? Who would re-organise the funding on a number of bases, and it is an expensive field, as you know only too well? Would you?

(*Professor Davies*) We would indeed.

258. So you do still have a strategic role?

(*Professor Davies*) We do indeed. We have at-the-table involvement in the London Implementation Group, which is looking at the implementation of the Tomlinson recommendations. Furthermore, we have responsibilities for looking at the manpower implications of the Standing Committee on Medical Manpower, who have recently reported and from whom a report is going to our Council tomorrow to discuss the implications of that. So certainly we have that form of global review, but in terms of going down to a rather specific sub-subject level our brief would, I think, more be a watching brief to ensure that, for instance, everybody did not abandon Russian because it happened to be out of favour. To that end, one of the re-organisational steps that I and my colleagues have put in place is to have a very active Institutions and Programmes Division, which is enlarged—we have been resourced so that we have been able to enlarge it—in comparison with our predecessor councils. So there is frequent movement of the staff of the Council through a regional officer structure into the institutions, so that we have a closer flow of information from the Council to institutions and particularly from institutions to the Council, and from time to time they will identify issues which then are turned into policy issues by Mr Bekhradnia and his colleagues in the Policy Division. To some extent the libraries review is a reflection of needs in that sector which we then seek to bring together.

Chairman

259. Your mention of Russian is a perfect example of where somebody, it seems to me—because Russian is now becoming more popular—ought to be trying to operate against local and temporary fashion and these things are happening all the time, new perceptions of why one should do things, after all?

(*Professor Davies*) Yes.

260. Since the Research Councils seem no longer to adopt a long-term point of view in that sense, if you do not, I do not know who will.

(*Professor Davies*) I could not but agree, my Lord Chairman. Perhaps I can cite another example. We recently put in place a specific review of the activities of the School of Oriental and African Studies to ensure that a great deal of the expertise, often, oddly enough, in some of the countries around the Eastern European borders, was not lost again because it became unfashionable, with the intention of giving to these specialist institutions a long-term stability that says, "Here is a funding methodology which is not dependent upon the vagaries of the short-term student demand."

Lord Tombs

261. Could I ask whether the lower weight being put on subject review stems from conviction or resources?

(*Professor Davies*) I think it would probably be fair to say mainly from conviction on the part of the Council that the management and much of the detail of the institution is the responsibility of the institution.

262. That is a good argument for not having a Council really, is it not?

(*Professor Davies*) I would argue that it justifies our existence because it allows us to make allocations to them in broad terms which are not narrowly determined.

Lord Dainton

263. The more you define your formula, of course, the more you argue yourself out of existence.

(*Professor Davies*) I recognise that absolutely. That is why I think as a Council my Council would resist resolutely earmarking or indicating grant in a sub-divisional way.

264. But supposing, for example—and you know this case very well—there is a crisis in subject X, we will say in engineering, and the nation obviously needs more engineers who have a broader education. You know the initiative to which I am referring in 1977?

(*Professor Davies*) Indeed.

265. Would you still be able to do that and would you have a mechanism for identifying areas in which that kind of thing should be done?

(*Professor Davies*) As a Council, we would probably not have the immediate mechanism, for instance, for us to determine in advance of the sector that there was a need for these initiatives, say in physics and mathematics, but we do then have the mechanisms for reflecting that. Only yesterday we were involved in a quite vigorous exchange with our parent department about the need for selective four-year courses in areas which must be seen as priority areas, which is essentially taking your 1981 initiative and seeing it developed in other areas.

Lord Butterworth

266. I was interested in what you said earlier about the transfer of funds from the Funding Councils to the Research Councils. It seemed to me it led logically to a further question and that was, is there any evidence from the point of view of the Funding Council that what has already happened, the transfer that has already taken place, has already gone too far?

(*Professor Davies*) There is, I think, quite strong evidence—and I allude to it with regard to some specific institutions, one of which you will know extremely well—that one of the consequences of the transfer was, in the short term at least, the failure of the commitment to ensure that the funding that came out of the Funding Council would return to the institutions through the new mechanisms that the Research Councils were going to operate. Sadly the signs are that in a number of areas, it is our best institutions in research terms, Oxford and Cambridge and University College, Imperial and Warwick, which have suffered. There is available—and your Lordships may not have seen it yet—a report from the British Universities Representative Group of Finance Officers, which shows that there are some quite serious issues. I believe, for instance in the case of Cambridge, that the short-fall in the first year is something of the order of £4 million.

Lord Dainton

267. How much?

(*Professor Davies*) £4 million. This is something which is being dealt with and is—I have to be very fair—uneven between the Research Councils. The perception is (or the evidence is) that four of them have problems which are very small. The Science and Engineering Research Council has created some problems which are quite substantial.

268. This is a good illustration of a necessity for you to be involved in the ABRC in order to be able just to defend this kind of situation and see it does not happen, is it not?

(*Professor Davies*) I would argue, yes. In an informal way, one of I suppose the more pushy things I have done is I have persuaded the meeting of HORCs (the Heads of Research Councils) to admit me on a regular basis, so that I can argue about the inequities that have occurred because of the transfer and quote evidence from the individual institutions for which we are responsible.

269. In order to be directed on that sort of inequity, you need to be there *de jure* rather than just *de facto*?

(*Professor Davies*) I certainly would support that view very strongly.

Chairman

270. Let us turn to structural issues. I have another example where it seems to me you ought to be in a position to do something. Somewhat to my surprise, Sir Mark Richmond announced to us when he came to give evidence a few weeks ago, that he was thinking in terms of supporting excellence in science, wherever it occurred—not necessarily in the higher education sector. That is fine, of course. That is a return to DSIR, which some of us would like; but of course the amount of money has not been increased to allow for this and therefore, if it is carried out (and this is only an idea as I understand it), the amount of money that goes to support research in the universities would decrease. That is a matter which you should have a view about and should be able to express?

(*Professor Davies*) Indeed.

271. Have you heard about this? Have you had an opportunity to discuss it?

(*Professor Davies*) My Lord Chairman, this particular issue has not been presented to us as an issue for us to have an input to at this stage. We have had, of course, a number of discussions with the Research Councils about the balance between the funding of research in universities and the funding of research in their own institutes and as you are—I am sure as a committee—well aware, there is very different practice between the different Councils. Certainly in so far as there may be shifts of project funding away from the universities to institutions outside, this has not been an issue which we have been intimately involved in.

272. If it became a somewhat hotter issue than it has so far, through what mechanism would you play your part in that?

273. ....

(*Professor Davies*) We have assessor status on the SERC, but this usually means that we do not get very much involved in the deep policy issues before they appear at Council level. It would be of great value were we more readily able to do so and one of the issues which I have recently put to the Chancellor of the Duchy, through the Chief Scientific Adviser, was that there should be some form of co-ordinating committee that allowed us to do that. At the moment we are unable to have the impact that I believe would be necessary, not least because of one of points I make here. There is no doubt that in terms of the totality of research that takes place with public support, the universities are the major player.

274. Now that you are responsible to the Department for Education and the Research Councils are responsible to OST, a different department, it seems to me to be even more important that there should be some sort of formal link between the two, where you can join forces?

(*Professor Davies*) I would agree with that.

275. And there is no such thing being discussed seriously at the moment, so far as you know?

(*Professor Davies*) To develop my point, I made the point about co-ordination in the context of the White Paper which was being drafted, with a view to seeking to have some form of structural element included in the White Paper; whether that will be the result of pressure, I am unable to predict.

276. We shall see. I would like just to go back to the point of whether you are in a position—if I may put it slightly pompously—to speak up for the health and prosperity of the higher educational sector, as a totality, especially where research is concerned?

(*Professor Davies*) I believe that as a Council we are, in two ways. Firstly, through the normal Governmental channels, of which we are a part. So that for instance, when we make submissions, even under the new PES rules we can bring out our perceptions of where there are pressure points. One of these areas is in the area of research, where if one

[Chairman *contd.*]

compares the development of research support through direct Government channels in comparison to the development and research support through some of the external sources—through industry, through some Government departments, through the Economic Community—then these have not followed togther and this has created some pressures on institutions. We can then voice that publicly and voice it through the Government channels I referred to.

277. I do not want to hog the questioning, but let me just turn this question around slightly, given what you have just said. Do you find that, for example, SERC regards itself as having a responsibility towards the health and prosperity of the universities as I put it before, or is their responsibility much more narrowly towards the support of science and engineering and to hell with the institutions?

(*Professor Davies*) My personal perception is much more inclined towards the latter interpretation, other than where, for instance with institutions there is a specifically broad sub-set of activity which is seen to be of fundamental and long term importance. Perhaps some of the reflections of that have been where the SERC has funded a series of rolling grants, where a rolling grant operates often almost in a manner which is a dual funding manner; but apart from that, I would believe—and I have had the occasional eyebrow raised when I have expressed this view—I believe that the Funding Council has a responsibility to be the champion of the universities.

Lord Dainton

278. To return to this structural problem a little more, to the neat and tidy and therefore unproductive and unimaginative mind, it might seem that the obvious thing to do now we have a Department for Education, not science, was that that part of your vote which is devoted to research really should be determined elsewhere—obviously the Office of Science and Technology. Do you see that as a real danger? Do you know how your total budget is determined in compartments and are you sure that that allowance for science, which you regard as so vital, can be preserved?

(*Professor Davies*) It in a sense goes back to the question that Lord Chorley asked about plurality. I believe in some ways that at least having our funding stream through the Department for Education makes its preservation more likely. I think that there was some debate, as you, I am sure, are aware, that perhaps we should be the recipient of moneys from two funding streams. I believe that would become a time where the temptation to couple the short-term priorities of Research Councils to the medium- and longer-term priorities of universities might be irresistible. While there is an interdepartmental barrier between the two I think the probability of that being resisted is much greater.

279. Do you see it as a present danger now, as it were, that things are up for grabs and Mr Waldegrave was asking for views before producing his White Paper, that it might be attractive to officials in his Department?

(*Professor Davies*) It would be very improper for me to presume very much about what is in the White Paper. It is quite clear that there is a very strong difference of opinion between the officials in the Office of Science and Technology and the officials in the Department for Education. I am led to believe—and I have to put it in those terms—that the recognition of the importance of the two streams of funding to universities is likely to be endorsed in the White Paper but I can say no more than that. I suspect your Lordships are better informed about this than I am.

Baroness Perry of Southwark

280. But does this not take you back to your earlier point, that somebody needs to be in a position to take an overall view of the position of the universities? If you were only able to take a view of the teaching functions of the universities you would lose that overall totality of view? Would that not in itself be a loss to the Science Base?

(*Professor Davies*) I believe it would, quite definitely.

Lord Porter of Luddenham

281. Following that up, your general policy is to support excellence in research but, as you are well aware, excellence is a snowball and it tends to build up; the better it is the more support it gets. Do you have a positive policy of seeding where there is not excellence, especially in the new universities and so on? You believe in selectivity, but if you also believe in the flexibility to grow to excellence, what is your policy? What are your methods of supporting the new and small and potentially growing institutions?

(*Professor Davies*) I think there are two aspects of that. One of them is, as I referred to earlier, the existence of what we call Development R, the money that goes in is unpredicated but is dependent only upon institutions having a strategy for using it in a way which will seek to build upon what seeds of excellence they have and take them further. So that mechanism does exist.

282. So again it is bottom up? They put forward a proposal and you assess it?

(*Professor Davies*) We have allocated the funding to them and have said, "The release of that funding requires you to have a sensible broad strategy." We would not expect them to come forward with a strategy that said, "We are going to work upon the structures of a particular polymer," or something of that sort. We would expect their strategy to be one that says, "Perhaps our excellence in the research assessment exercise embryonically has been identified as being in media communications or in applied research related to vehicle design," and we would seek to see them build upon that so that the seed can be nurtured. In the other terms, where they have developed excellence through the redeployment of their own resources, often on quite a narrow base, we have sought to allow them to bring that excellence out in a way that is reflected subsequently in funding. A very important element of the last research assessment exercise was asking institutions to identify their research-active staff and bring them

[Lord Porter of Luddenham *contd.*]

forward to be assessed. So that even within in perhaps a broad area of activity, in mechanical engineering, a new university may have had an activity which was comparatively narrow, certainly in terms of perhaps a traditional civic university. They could identify that sub-set, they could bring it through, and there are a considerable number of these as a consequence assessed at 3 and 4 and one at 5. They then attract the funding through the quality route, which is exactly parallel with the funding that the traditional universities attracted, so they are getting it two ways.

283. Would the ultimate objective of your Council follow the view that all our 100 universities really ought to have some area of research, or do you go for R-T-X?

(*Professor Davies*) No, I think we would believe that they should all have some activities of research. The difference between them will largely be the volume. I am known to talk about universities with degrees of R-ness and degrees of X-ness and degrees of T-ness, and I think that is the factual position at the present time. What we would seek to ensure is that there is enough flexibility in our funding stream to allow institutions to make slow—because the time constant of research is very long—movements within that spectrum and not to freeze the system.

284. But you would like to see a seed or two in every one of them?

(*Professor Davies*) Indeed we would.

Baroness Perry of Southwark

285. And I believe that is the case, is it not, in one sector, that every university did have seeds of excellence?

(*Professor Davies*) It is indeed.

Earl of Selborne

286. Could I go back to structures. Professor Davies will know that the idea was mooted by some that there should be another Research Council, a Humanities Research Council. Do you feel that would have any role to play in funding higher education institutions?

(*Professor Davies*) We have been supportive of that as a general policy. I have been at pains in a number of public domains to remind different bodies that there are very important elements of research in the humanities which are not currently supported other than through ourselves, and to some minor degree through the British Academy. It was an important part, I believe, of the return of the Advisory Council on Science and Technology in its submission to the White Paper debate, to remind others that there is funding that goes into the higher education sector other than into science and technology, and I believe it is funding which is of value on a national basis as well and, dare I say it, is often of great value in terms of wealth-creation.

287. So if that were to be created, where should it be funded from? Is it a further transfer of funds or is it another hat which has to be filled?

(*Professor Davies*) My belief, quite naturally, is that if it is to be project-oriented funding, which would be necessary if it is to be activity that parallels the existing Research Councils, then it could embrace both the current funding that flows through the British Academy, some of which is almost project funding, and it would require new money if it is to be used in this project-oriented way. The totality of funding that we as a Funding Council are at the present time able to provide for the humanities is constrained.

Lord Porter of Luddenham

288. What are the advantages of however much extra money, even if it is zero, of transferring it from the British Academy, which, after all, is a bunch of peers in this respect, to yet another Research Council?

(*Professor Davies*) These are arguments which have been rehearsed by people better equipped than I. I think the perception is that there are some areas of the British Academy's activities, particularly those in the studentship areas, where nobody would take issue but they might argue that they are not equipped in terms of their structure and their current organisation to operate the form of peer review committee structure for projects that is the practice, for instance, in the Economic and Social Research Council, which is a near neighbour in many respects.

Lord Chorley

289. Now that we have a single Funding Council and twice as many universities, and in that sense we have actually got less plurality than we had before and the whole scale is very much bigger, do you see a difficulty in keeping up your, as it were, sensitive tuning on selectivity and pushing a bit here, a bit there? Are you being driven more down through the sheer weight of the thing?

(*Professor Davies*) No, I do not see that as a risk. As I said a little earlier, part of my deliberate policy, within the organisation in creating its own infrastructure, was to ensure that as the sector has expanded the bringing together of the two staff bodies has been reflected in this internal re-organisation such that we build a very strong network of interactions into the institutions. If I may pick up the first point you made, with respect, I would argue that there is not less plurality, there is more, because previously the Polytechnics and Colleges Funding Council did not fund research.

290. At all?

(*Professor Davies*) Hardly at all.

Lord Dainton

291. May I just ask you a question which is related to organisation, but a different division of organisation, which is a territorial one? Given that United Kingdom students can go anywhere in the universities and research can be done anywhere, and the remit of the Research Councils is United Kingdom wide, does it create difficulties for you to have two sister Higher Education Funding Councils and if not, why not? I mean, because your policies must be in step, otherwise the relationships with the Research Councils will get distorted in one way or another?

[Lord Dainton *contd.*]

(*Professor Davies*) There are difficulties. You find in the document I made reference to the fact, without giving specific details, that already there are differences in the funding methodologies. If I may take a moment, Lord Chairman, we use a weighting in the quality elements of research, which goes: One, two, three, four. So that a grade five department gets four times the weighting of a grade two department. Grade one departments receive no direct funding. The Welsh Higher Education Funding Council changed this weighting, so instead of being a linear one, two, three, four scale, it emphasises grade three, because they have more grade three departments than they have grade four or five and they wanted to encourage that.

292. They wanted to-?

(*Professor Davies*) Encourage and support the grade three department, whereas we have concentrated our emphasis on the grade four and grade five department. The Scottish Higher Education Funding Council adopted a geometric scale that goes 1, 1.4, 1.96, 2.74, so that they again have put much less weight upon excellence than has the English Funding Council and I think this could cause some longer term difficulty.

293. It would incourage intelligent researchers and who is not an intelligent researcher—to migrate, to say the least?

(*Professor Davies*) There is another very important issue, where we think there may be some difficulties on a regional basis and this is the way in which other forms of developmental research funding can flow into the institutions through other departments. The ability of both the Welsh Office and the Scottish Office to fund the form of near market research I referred to earlier, is not reflected through an equivalent English Office. Although we have made approaches to the Department of Trade and Industry and the President of the Board of Trade has had this issue drawn to his attention, it is unlikely there will be a regional funding policy for England that will mirror the regional funding policies that exist in Wales and Scotland. This will be to the disadvantage of the English universities.

294. Is it possible that under this separate arrangement, that transferred funds might vary as a proportion of the total funds paid to Research Councils, the sectors, because this would create really a discontinuity which would be different?

(*Professor Davies*) It certainly could and has, if I may again take an example: The agreed transfer of funds within the public expenditure stream was made before the UFC as it was, had taken the final steps in terms of selectivity. So that we we began to change the formula from a scale of one, two, three, four, five, to one of one, two, three, four, dropping out grade one. We got half way there when the funding streams were split up. If you do a calculation of what would have happened to Wales, if they had transferred a year later than when the division was made, they would have received some £4 million less than they did receive. In fact there was a division which was more strongly supportive of the Welsh universities than continued research support through a national Universities Funding Council would have been.

Chairman

295. There is nothing to prevent you from developing variations of your formula for the Northeast and Southwest and for London and so on, to reflect local or regional needs. Why do you not, since Scotland and Wales do it already?

(*Professor Davies*) I think we would argue that within an institution's flexibility to operate, if it wished (as it frequently does) to collaborate with institutions within its immediate region or elsewhere, it would necessarily and sensibly deploy its own funds to do this and they do.

Lord Dainton

296. The difficulty about this is that different values are attached to the same quality of work in different places and that does seem to be a nonsense in an area where there is free movement of people?

(*Professor Davies*) Indeed and certainly, Lord Dainton, in so far as the discussions between the officers of the Funding Councils are concerned, there are concerns that there may be some form of hierarchy between the Funding Councils, which is one of the reasons why at the moment there is a public commitment to a national research assessment exercise. I think it would be very damaging were this public commitment to be withdrawn from in any way, because then I do believe there would be serious risks.

297. Is there no movement towards harmonisation of methods?

(*Professor Davies*) The way in which the Acts are worded put no pressure on individual Councils to harmonise and it is my personal interpretation that the nature of the circumstances are such that individual Councils will seek to develop their own individuality.

Chairman

298. We must not speak in a rather colonial fashion about Scotland and Wales. They have a perfect right to develop their own criteria in their own way. That is plurality.

(*Professor Davies*) If I may, I do believe that if there were any consequential developments that inhibited what we might loosely call "cross-border" flow of staff or of undergraduates or of postgraduates, then that could not be in the joint national interest.

299. You give in your very useful paper the T, R and NFF split. What is the rationale behind the 62 per cent, 24.5 per cent and 13.5 per cent, or is it just history?

(*Professor Davies*) It is largely history. It is bringing together one sector, UFC, which was basically 60T/40R and another sector, PCFC, which was basically 100T/0R. With small variations, of course, we did inherit some institutions from the Department for Education, the Open University, Cranfield and the RCA, where the split was 80T/20R. The non-formula funding appears to be very large. This is because the bulk of that funding is in fact in London allowances.

Chairman] Thank you very much for your time and we are grateful to you.

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HOUSE OF LORDS SESSION 1992-93

MINUTES OF EVIDENCE
TAKEN BEFORE

THE SELECT COMMITTEE ON SCIENCE AND TECHNOLOGY

SUB-COMMITTEE I PRIORITIES FOR THE SCIENCE BASE

Wednesday 5 May 1993

ECONOMIC AND SOCIAL RESEARCH COUNCIL
Professor H Newby and Mr C Caswill

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WEDNESDAY 5 MAY 1993

Present:

Butterworth, L.
Chorley, L.
Dainton, L.
Dean of Beswick, L.
Perry of Southwark, B.
Porter of Luddenham, L. (in the Chair)
Tombs, L.

Examination of witnesses

PROFESSOR HOWARD NEWBY, Chairman, and MR CHRIS CASWILL, Director of Research, of the Economic and Social Research Council, were called in and examined.

Chairman

300. Professor Newby, Mr Caswill, you are very welcome. As you know, I think, our present enquiry is about how priorities for the Science Base are set and, even more important, how they should be set if they are not set properly. We are not in the business of setting them in this Committee at all, nor are we in the business of making any judgements about overall funding. We have to assume that that has been decided, and we have to take it over from there. On those lines, I wonder whether you would like to make an opening statement about anything at all?

(*Professor Newby*) I would simply say that setting priorities is possibly one of the most difficult policy tasks which all the Research Councils face. It always involves a balance and, in the end, a judgement, I think, between what on the one hand has come to be known as the responsive mode approach, which is that one receives unsolicited applications and judges them on their merits, and on the other hand a more proactive approach in which one attempts to identify areas of science, or in our case social science, which need positive stimulus by my Council. Whether it is priorities in terms of funding or priorities in terms of actual areas of enquiry, one is always grappling with a balance to get it right.

301. I wonder whether you could begin by telling us how—if it does at all—the ESRC differs from other Research Councils in its problems of setting priorities particularly?

(*Professor Newby*) I think we differ in two important senses. First of all, the ESRC has no directly-employed research staff, which makes us different to three of the other Research Councils (and arguably four, depending on how one views the central facilities of the SERC).

302. In the sense of having your own institutes?

(*Professor Newby*) Yes, we have no institutes. All our research spend goes through the universities or through independent research organisations. That means that, for example, when we are talking about setting priorities we are engaged in what I would call back-seat driving to a degree. I am sure that in the changing climate we find ourselves in, with the White Paper in the offing, this is something which you and your colleagues may wish to explore as the enquiry proceeds, but that is a very great difference. Secondly, I would say that there is clearly an issue which may or may not have occurred to you and your colleagues, and that is this. In the social sciences, whether we like it or not—and I think that on the whole we probably do like it—we certainly do have to pay rather greater attention to the issue of timeliness of our research than arguably the other Research Councils do. They do from time to time have to pay great attention to that as well, but we do wander into areas of quite major immediate public concern where I think we have a responsibility to be engaged in work which can inform the public at large. Clearly, when you are talking about priorities and, if you like, intervening in what the community, left to its own devices, would wish to pursue, then this issue of timeliness is one we have to grapple with, and it is very difficult anticipating what will be timely by the time the research process is completed, very difficult indeed. I think that timeliness is more important for us than for other Research Councils.

303. You feel this is more so in the case of ESRC than, say, the Medical Research Council which has a few timely problems itself?

(*Professor Newby*) Indeed. I am not saying for one moment that other Research Councils do not have to face up to the issues of timeliness from time to time. In the case of the MRC, something like the Aids pandemic comes along and the MRC needs to switch resources to tackle it. The AFRC has a problem with mad cow disease and has to switch resources—as does the MRC—to tackle it and grapple with that. When we are looking at the range of our portfolio, I think that timeliness is more of an issue with us than it is to other Research Councils. Also, knowledge proceeds in the social sciences in a less linear additive way than in the natural sciences.

304. You would seem to be saying that perhaps there are not the obvious long-term basic problems in the social sciences that there are in the natural sciences. Some problems in biology, for example, are absolutely obvious long-term ones, they must be done one day or another—for example, human genome sequencing. Others are not long-term basic problems.

(*Professor Newby*) We have long-term basic problems, but if you take the genome sequencing as an analogy, they are not dealt with in that rather additive manner in which one builds in that particular case on very small building blocks one

[Chairman *contd.*]

after another until, at the end of the day, after many years in this case, one has arrived at a complete sequence. The social sciences do not proceed in that way.

305. Perhaps I gave a bad example there. Perhaps the causes and cure of cancer would be a better example. That is not a stepwise procedure, is it?

(*Professor Newby*) In that sense, I think that we do have similar long-term problems. The problems of competitiveness of the British economy, the problems of crime, the problems of poverty, whatever, are long-term problems. However, I think that I would draw a distinction between the nature of the problems, where we have just as many long-term ones as the natural scientific community, and how they are approached, where I think the pressure on social sciences is bound to be affected more by the way in which society itself is changing. The actual thing you are looking at is not fixed and the object of study is not fixed, it changes as well as social science changes at the same time. That is not, on the whole, true of the natural sciences.

306. More ad hoc?

(*Professor Newby*) I would not say "ad hoc" either. I think it is quite a difficult issue. Knowledge in the social sciences is additive. We do know more now than we knew 10, 20, 30, 40, 50 years ago, but what it is we know about, our object of knowledge, is itself changing as that knowledge is accumulated, so knowledge in the social sciences is cumulative, but it does not accumulate in the same way as in the natural sciences. For example, two chemicals reacting in a test tube will nearly always react in the same way in a hundred experiments. The social sciences are not like that.

307. Having seen that there is a difference here, and that perhaps you have to be a little more short term, how, within those restrictions, do you then formulate your priorities? What are the priorities? Are they based mainly on demands from customers?

(*Professor Newby*) Like all the Research Councils we have a process, through our corporate planning cycle, in which, on an annual basis, we assess priorities. At the present time a lot of that is engaged through a process of what we call strategic reviews. The priorities for those are laid down by Council, and through the strategic review mechanism we indeed consult the academic community and the universities. It works through our discussions with learned societies, for example, or other representatives. We also discuss these matters with the customer community, and into that category I put business, government departments—we have a large number of government departments to deal with—local authorities and other public bodies, charities and universities. As I was hinting earlier, the important aspect of this process is really what is the appropriate mix between what one might call the bottom-up approach to establishing these priorities and a more top-down approach. Clearly we have to be influenced by Government's own priorities which it sets with all other Research Councils through its policies and then they have to be melded in some way with the views both of the customer community and of the research community.

308. On this matter of the criteria that your Board has to use, are there any other criteria any different from the natural sciences?

(*Professor Newby*) No.

309. We have talked already about the differences in the Council but what about the criteria for priorities?

(*Professor Newby*) No, there are not. We explicitly at the ESRC use the ABRC criteria, and I mean "explicitly". When Council and our boards sit down and decide upon priorities for their work they use explicitly those criteria as a guide for their actions.

310. I believe you have a new Board structure?

(*Professor Newby*) Yes, we have.

311. Would you like to tell us a little about that?

(*Professor Newby*) Yes. We re-organised ourselves last year to create five executive boards with devolved budgets and they match on the research side the different modes of funding under which we operate, that is, grants (responsive mode grants), a research centres board, a research programmes board, and then we also have two other boards, a research resources board, which looks after what one might broadly call infrastructure issues, and a training board, which looks after our postgraduate training. So we have five boards and they work within the framework set down by Council, and I have created within Council a Strategy and Resources Committee to undertake most of the important work on precisely the area which concerns this Committee of setting priorities and providing that framework for the boards to operate within.

312. We have been talking, I suppose, really about your methods of setting priorities in your own house, so to speak, within the social sciences but I believe you have some quite optimistic views about what the social scientists can do for the natural scientists in helping them with their priorities. Can you tell us how you can do that?

(*Professor Newby*) First of all, I have been very exercised since I have been Chairman of the ESRC by the endemic two cultures problem we find in this country and I find many of the major issues, some of which you yourself have referred to, can be better informed by social scientists and natural sciences colleagues working alongside one another. In some areas this almost falls out naturally from the definition of the problem when you think of areas such as health, environment and so on. Recently also I have been struck by the way in which also, given recent debates on the links between the Science Base, on the one hand, and wealth-creation, on the other, the social sciences contribution has been rather down-played and how, in fact, we can demonstrate, I think, that we also have a lot to contribute there. This issue of inter-disciplinarity is a very difficult one to overcome. I think the Research Councils have some responsibility to encourage greater inter-disciplinarity, given the very discipline-bound nature of the way in which our universities are organised. I think we do act as a countervailing force in that regard. So I think, Chairman, what you had in the back of your mind was that our submission to the White Paper on Science and Technology, for example, has stressed the contribution which the

[Chairman *contd.*]

social sciences can make to the issues which are central to that Paper and to see that the process of innovation and creating an innovative economy in this country is as much a management issue as it is a science and technology issue, narrowly defined, and that innovation is as much a market-led as it is a science-driven process. I think the work of my own community has much to contribute to this but I recognise also that this two culture problem creates problems for research organisations and, indeed, communications between the various communities.

313. I am not sure myself that is our major problem. Our major problem is best illustrated by the specific example of how on earth you decide on the relative importance for funding and everything else of astronomy and molecular biology or the human genome. Only social scientists can help us with that.

(*Professor Newby*) In two ways, I think, yes. I think, first of all, social science can make a contribution to a recognition that science does not exist external to society, that science itself and science priorities are themselves the product of social and economic factors. You have taken, presumably deliberately, two very difficult examples but I think in the case of, let us take molecular biology, if you are asking what can the social sciences do to improve the quality of molecular biology research at the laboratory bench, then I think very little.

314. No, I was not really asking that, although I would be interested in your answer. What I was really asking was, how on earth do you choose the priorities between such dissimilar things as astronomy and molecular biology?

(*Professor Newby*) In practical terms, one chooses on two grounds. One first of all makes an assessment of the quality of the science being undertaken by those different disciplines so that one can make a judgment about where an investment of scarce resources will produce better results.

315. I think in both those cases you would agree the quality of the science is superb at the top?

(*Professor Newby*) One learns the notion of merit review, we want to relate the scientific activity to a series of, if you like, ulterior objectives, and that is where the social sciences come in because I think we can assist—and I am thinking of the work of the Science Policy Research Unit at Sussex—and do assist in various processes which I know you have some degree of scepticism about but which, nevertheless, we can and do assist, in areas like technology foresight, where we can relate the ulterior objectives of certain kinds of scientific activity to a national economic and social goal.

Lord Chorley

316. Given the "can", what interests me is the "where". Where can your contribution best be effective? Should it be within the base, within the ABRC, or should it be by the grant you make for particular studies, or should it be nothing too direct to do with the ESRC but should Research Councils have economists on their boards? It has been mooted in the Research Council that I have to do with and it is an interesting idea. I would be interested to know how you see the "where" in your contribution?

(*Professor Newby*) I think I will answer that question in two ways. First of all, I am very resolutely opposed to the notion that the role of social sciences is merely downstream of scientific advance, that our role is purely to lubricate the social acceptability or the diffusion of innovations which the scientific community has ordained.

317. Downstream in the sense of R and through to D?

(*Professor Newby*) Yes. I think social science has a great role to play upstream of the scientific process, as I have indicated, by assisting in the establishing of certain kinds of what I called earlier ulterior objectives. That leads me then to propose actually in response to your specific question a rather dual-track approach. I do believe that the social scientists have skills which can assist at the level of science policy-making but I also believe that at the individual Research Council level then certainly social scientists have again skills which can assist Research Councils and others in building into their own activities a greater understanding of social needs, market needs and other social and economic factors.

318. Or ways of making judgments?

(*Professor Newby*) Or, indeed, ways of making judgments. To give you one very pertinent example, at the present time I think all Research Councils and, indeed, other public bodies are very exercised about the notion of evaluation and that is an area to which social science is certainly contributing by the adoption of better, more sensitive evaluation techniques. Understanding more about the uses and abuses of evaluation techniques, whether it is performance indicators or anything else, I think is a vital contribution we make and that is not downstream of scientific activity; that is upstream.

319. I was not trying to suggest there was a sort of downstream—

(*Professor Newby*) There is a conventional point of view that science and science alone changes the world and then social sciences come along afterwards to tidy up some of the mess, and that is really a rather misconceived way of viewing what we have to offer.

320. With your knowledge, though, of ABRC and its debates, would you say it would be a good idea if social scientists were members of the boards of Research Councils?

(*Professor Newby*) I would certainly like to see in some areas the other Research Councils have access to social science expertise. Whether that is best served through membership of their boards or councils or whether in some other way I have no particularly strong view on, but we have found, speaking now from a social science perspective, certain judgments of the scientific community are constantly caught out or caught by surprise at public reaction to a number of their activities. Whether one is in the business of public understanding of science or, as I sometimes refer to it, science's understanding of the public, or whether one is in the business of technology assessment, I think these are issues which have to be addressed at the beginning of the scientific process and not left to the end.

Lord Tombs

321. I would like to go back, if I may, my Lord Chairman, to the question of priorities within ESRC, as you see them, and what you regard as the most pressing problems and areas. I would be interested in your comments, Professor Newby, on how you inform or influence Government policy. Perhaps I can take as an example what is generally regarded now as a fiasco, the Criminal Justice Bill. Did ESRC have any input to that, and if not, why not, and does it have any input to the probable reforms there, and if so, what form might they take?

(*Professor Newby*) I will deal with the specific question first and then broaden it out. On the specific question of reform of the criminal justice system, the answer is yes, we had a major programme in that area a number of years ago, now completed, which drew attention to a number of the issues which I think are now very current in public debate, and, of course, the Runciman Commission is also engaged in that in some way. We have also undertaken a programme of work associated with looking at the workings of the Police and Criminal Evidence Act, but the broader issue is, I think, the really rather delicate one of the relationship between social science and public policy, on which I have spoken publicly quite recently. I think it is very important, first of all, if I were to address my research community, and for my own research community to understand where social science expertise ends and public policy advice begins and not to confuse the two, which I think my community has confused historically. Of course, when one gets down to the business of day-to-day relationships with government departments—and our relationship is with very many departments, I might add, we do not have a single sponsor department to whom we relate—those relationships are conducted primarily with the research side of those departments rather than with the policy side, at least directly. One knows that however good one's relationships are with the research side of those departments, there is a further barrier to be crossed when their gathering together of all the knowledge that we can assist them with is passed on to the policymakers within their own departments. So I think that a good deal of our relationship with the policymakers in government occurs in that rather indirect fashion. There are one or two exceptions to that, but on the whole that is true. The one exception which I am sure might interest you is, arguably at least, over our relationship with the Treasury where, because we fund in conjunction with them and with the Bank of England work in macroeconomic modelling, we find that often our links with policymaking are a little more direct than they might be elsewhere, although that is not to say, I hasten to add, that we are any more influential. I think there is quite a distinction to be made between the ESRC and the community I represent as the provider of knowledge which can assist in policy making and then the use which is subsequently made of that knowledge to make decisions.

322. I think this does lead back to the question of how you set your own priorities, because you mention, with some justice, that scientists often are surprised by the public reaction to their proposals. The more surprising is that politicians are surprised by the public reaction to their proposals. Therefore, I would have thought that high in the list of your priorities ought to be highlighting the issues, not necessarily through highlighting advice but perhaps through publication of reports before decisions are made. I would like a feel of how this rates in your system of priorities, how important you think that is as a means of dispensing the funds which the public, after all, provides.

(*Professor Newby*) I can say, very highly. One of the frustrations I have as my Council engages in this form of back-seat driving is the communication of the research results which we have assisted in supporting. I believe very strongly that we have a lot to say which is of wide public interest and which the public at large as well as particular practitioners need to make use of. I am constantly frustrated by the inability of the community I represent to put over the results of its work in words which are intelligible to a wider public. We have worked very hard at this. We have done, I suppose, what one might call the more routine things. We have put all our research directors through media training courses. We have instituted performance indicators in their contracts for publication of results beyond the academic community, with only limited success because we are facing the whole weight of rewards in the university system at large which rewards people to publish in academic journals which are not widely read, through their promotion prospects, salary increases, research assessment exercises and so on, against which I am afraid a very small Research Council like mine can offer very limited countervailing rewards. More recently we have taken a rather more corporate view of this. We have decided to gather together in the office, with the assistance of some others, the research findings which have emerged from a wide range of ESRC-supported work on innovation. We have gone through quite a lengthy process of digesting that into a form which is accessible to the general public, by hiring a journalist to help in that task. That produced a document which will be known to some of you, which formed the background to a series of lectures we recently held at the Institution of Civil Engineers under the title of "The Innovation Agenda". That has worked quite well, I think, in putting over to a wider public what we do have to offer, although I think I would say in retrospect that with regard to one of the key target audiences of that exercise—namely, industry—we were a little disappointed by the response there. We think we lack perhaps the credibility in industry at large—that is something we shall have to work on. There we think we may have to work, at least for the time being, through various intermediary organisations like the Institute of Directors, the CBI and so on. My community has suffered in the past from its unwillingness and its inability to put over what it has to offer. It is something which is very much at the top of my priorities.

323. I can understand your frustration about the innovation discussions, and I think you are quite right that there is a credibility problem there which may be very biased and unfair. However, it would seem to me that a way of acquiring credibility is to comment on very current topics which reach everybody, like the Criminal Justice Bill, like the community charge proposals, things of that kind, which do have tremendous impact and would suffer

[Lord Tombs *contd.*]

from a lack of research, a lack of commonsense approach, and certainly in the case of the health service, for example, a lack of pilot experiment and best practice.

(*Professor Newby*) I am sure that is right. We have to do it with great care, bearing in mind the distinction I drew earlier. We as a Council wander into areas of extreme political sensitivity from time to time.

324. I think you should.

(*Professor Newby*) As you know, my Council has a history where our contribution in these matters has not always been appreciated.

325. I think the way to avoid that is not to duck it.

(*Professor Newby*) I think the way to avoid it is to make sure that what we fund is of the highest possible quality and therefore will withstand critical scrutiny.

Chairman

326. You are in a bit of a cleft stick, are you not? You must be scientific to be sound and politically neutral, and this is very difficult.

(*Professor Newby*) It is not always achieved either by overstepping the mark, as I have hinted, and going beyond providing a range of knowledge which people can make use of to meddle in what are essentially political judgements.

327. Whilst we are on this slightly peripheral but rather important point, would you think it should be almost an unwritten rule that scientists investigating a certain problem should not make public pronouncements of a personal nature about the political nature of their problem? You know as well as I do that there are people who do that—you even fund some of them!

(*Professor Newby*) I think we are dealing now with the question of scientific authority. The public at large still, despite all the trials and tribulations, look to the scientific community to speak with authority and with independence. I think that scientists need to think very carefully, as I am constantly stressing, before they do anything which might undermine that authority in the sense of the trust which the public on the whole does have in them but which has been sorely tested from time to time, not least in recent years.

Baroness Perry of Southwark

328. Professor Newby, I should declare an interest as a former member of your Council. I have been listening with some anxiety to some of the questions so far because I feel that we are almost pushing you into a position where you are defending social science as always a handmaiden to something else, either to the physical sciences or to public policy, and I have a strong belief myself that the social sciences exist as sciences in their own right or as fields of human knowledge in their own right. After all, physical sciences do not justify exploring scientific truths by giving all their aid to something else but as a pursuit in their own right. That would lead me to look very strongly to the priorities which the social science community bring from the bottom-up half of your model. It must be, must it not, very important for priorities to be set by the imaginative, bright, perhaps young, members of the research community in social sciences who identify for themselves areas which might at the time appear to have no applicability either in the public or private sector but which nevertheless are worthy of pursuit in their own right? Is that not a source of priorities which we should explore in determining priorities?

(*Professor Newby*) Yes. My Council at the moment allocates over one-third of its research budget to that unsolicited activity. It is our policy to have no policy with regard to that research except having the highest quality research, so our research grant scheme is not steered towards any particular area of social science or discipline or institution or region of the country. As I keep saying time and again to my colleagues, we fund on the basis of quality and not on the basis of geography, so we are talking again of the business of balance. One must, any Research Council must, within its own dealings allow sufficient opportunity for bright scientists or social scientists to come forward with ideas and to pursue them. Equally, it has to be said that a community left purely to its own devices will not necessarily come up with a portfolio which serves the national interest (if I may put it that way). We also, as a Council, have to balance those opportunities which we do give with the need to consider, as I mentioned earlier, timeliness, to consider sponsoring and nurturing emergent areas of science which would not otherwise be properly supported, and to address areas of public concern or public policy where we think we can make a contribution, indeed in some ways, I might add, create research communities which are not there because of the way in which the universities themselves are organised.

329. Can I pursue that last thought? We have heard a considerable amount from some other witnesses about the difficulty for bright young scientists in finding a niche for pursuing their own particular interests. They are obliged always to go to where there is funding and that very often, at least of the case of the physical sciences, means a fairly large rolling programme of research where they have to bend their own interests because that is where the money is. Is that a problem social scientists feel to a lesser degree or is it something of which you are conscious?

(*Professor Newby*) This is something we feel to a lesser degree because the social sciences are not organised around major investments and infrastructure in the way in which many of the natural sciences are, typically, of course, big science, so-called. It means, incidentally, that when we come to make our judgments we are rather more concerned with the issues of selectivity; we select on the basis of quality rather than concentration since in most areas, not all, of the social sciences economies of scale are not there to be captured. So we have to make sure that we run a competitive system and allow as much openness into that system as we possibly can manage. Having said that, there are, nevertheless, I think, some quite fearsome problems of what I might call market entry because of the way in which the funding of research in the higher education institutions is going. Where you are, which institution you are

[Baroness Perry of Southwark *contd.*]

located in will in the future make a much greater difference to what I might call your life chances as a researcher than it did in the past, and I think this is something we are very alert to. My Council later this year will be considering proposals for enhancing opportunities for good researchers, wherever they can be found, of whatever age. Although our funding is concentrated in a small sub-set of universities, that is the outcome of the peer review process, it is not an input into it. I think for many of the other Research Councils they have to consider really making quite massive investments in equipment in one place and then have to manage their affairs so that they can ensure that good science is done in that one place. We are not quite in that position, although I would simply draw to your attention the importance of libraries, which is often forgotten in the equation, where major investments in libraries are of great interest to us.

Lord Butterworth

330. I notice you have twice described yourselves as a back-seat driver and then you were later on likened to a handmaiden. Of course, the danger in back-seat driving is more, I would have thought, associated with mothers-in-law! I would have thought that you and your colleague social scientists have a real input into the processes by which priorities in science are identified, and I was very interested in the answer that you gave to Lord Chorley about the techniques of evaluation. I am not asking you to guess what is going to be in the White Paper but what are the kinds of either procedures or structures which you and your colleagues would confidently expect, if the White Paper is going to be a success, ought to be there?

(*Professor Newby*) First of all, I would start, if I may in the presence of such eminent scientists, from a position where it has taken, in my judgment as a member of the ABRC, quite a long time for the scientific community to come to the realisation that the resource for science does not come as a free good, that resources are scarce and that we always have to consider the opportunity costs. That is the first point I would make. The second point I would make is that science, in my judgment, is an activity which is in the service of society as a whole and that the one thing which the social science community shares very deeply with the natural sciences is our view that society—I will not say can be perfected but society can be improved by the application of knowledge; in other words, there are ulterior objectives to science as an activity but the objectives of science cannot be determined solely by the scientists themselves according to scientific criteria. If we take those two points, that science involves opportunity costs and that the objectives of science must to some degree at least always lie outside science itself, then I think one can begin to develop mechanisms which will bring those with an interest in the ulterior objectives of science, the customers of science, if you like, those who are directly engaged in the business of using science to address economic and social objectives, to engage in a dialogue to achieve a sense of common purpose with the scientific community itself. So I would go on from that to argue, as one of our research centres, the Science Policy Research Unit—

331. At Sussex?

(*Professor Newby*) At Sussex—has argued, that we need in this country to undertake the process of bringing together the customers of science, wherever they may be, and the scientific community itself much more seriously and systematically than we have in the past. That would lead me to support the SPRU notion that we need a rather more systematic process of what they would call technology foresight. Technology foresight does not mean—I have to emphasise this—picking winners in the discredited sense of the past. It does mean systematically finding a forum in which this sense of common purpose can be achieved between the ultimate customers of science, on the one hand, and the practitioners of science, on the other. The value of technology foresight does not come from the particular recommendations on offer but from the actual understanding which is developed through the process of what each has to contribute. I think also I have to say it does offer some scope on the opportunity costs side of my argument, namely, it does enable Government ultimately, but initially perhaps the scientific community itself, to make more informed judgments rather than uninformed judgments about the opportunity costs of different kinds of scientific activity and to try to relate those to the benefits which might accrue. In the past I think science has been driven along by its own kind of internal logic and with a view that the resources will somehow magically appear, or that the resources of that particular scientist at the laboratory bench have appeared as a free good, they have not been costed; no-one knows the cost or even the value of them. I think that is rapidly changing and that is where the social sciences can help. I think the ideas that have been mooted towards engaging in the kind of activity that our major industrial competitors engage in in Japan, Germany and elsewhere in technology foresight are to be welcomed.

332. How in practice would you bring about these changes? I may have misunderstood, but are there any kind of structural changes or constitutional changes which would enable this kind of decision to come to the forefront?

(*Professor Newby*) I think that if you had been asking me that question a little over a year ago I would have said yes, but now I think the answer is no. We have now seen created an Office of Science and Technology whose responsibilities surely must cover this kind of activity, so the vehicle is there.

333. Is the implication of what you are saying, then, that this material ought to be prepared ultimately for judgements or decisions to be made in the Office of Science and Technology, probably by politicians?

(*Professor Newby*) I think that the Office of Science and Technology ought to be engaged in a regular round of technology assessment and technology foresight. The outcome of that should then, I think, be put back to a number of the interested parties, including the scientific community itself, for its

[Lord Butterworth *contd.*]

advice to go to the Chancellor of the Duchy of Lancaster for discussion with his colleagues.

Chairman

334. Perhaps I could clarify one point. I follow what you are saying so clearly about technology foresight and what the social scientist can do about that. I wanted to ask you whether what you have said has any relevance to the Science Base?

(*Professor Newby*) If one takes the Science Base in the conventional sense of that term, I think the answer must be yes. The Science Base in terms of the scientific community either in Research Council institutes or in the universities and the higher education institutions—

335. And if we mean, apart from the applied and strategic research, the basic science which is done without an immediate useful objective in mind?

(*Professor Newby*) I think the answer is still yes, because the innate processes of scientific advance which come from within the community itself have at some stage to be matched to the resources available, and that of course requires a political as well as a scientific judgement. What we have signally lacked in this country are effective mechanisms for that sort of convergence.

336. So that would be a matter of bringing the scientist and the politician together rather than the scientist and the industrialist, which was my understanding of what you were meaning?

(*Professor Newby*) The OST is there now as a mechanism which can handle this process, I would judge, certainly in potential, far more effectively than in the past. The OST not only has direct responsibility for that part of the Science Base which lies within the Science Vote, but it also has some oversight function for the Government's scientific activity across other departments.

337. And this was an important function of social science where it could help?

(*Professor Newby*) I would say that the OST would need to call upon the skills, and have employed within it the skills, of social scientists in this area of technology foresight and technology assessment, yes.

Lord Dainton

338. I am fascinated by this. I may have misheard part of it, and if I did misunderstand you, I apologise in advance. I got the impression that you were telling us fundamentally that the applications of social science were applicable throughout the whole of science. I can see that very clearly in strategic and applied science obviously that is true. I find it very difficult, as the Lord Chairman has been saying, to see how this can be applied to basic science. I can see how the expenditure of money on a particular activity carries with it an opportunity cost. That is obvious. You can list all sorts of things which might be done. However, I really do not know that there is any technique on earth which can tell us whether or not you can coax people into putting money into neutron research or alternatively how you are going to evaluate knowing something about the interior of the simplest particle we know which is nevertheless a composite, the proton. There must be some limit to your powers. I do not see how you can realistically make choices of a systematic, disciplined kind if outcomes are by definition unknown.

(*Professor Newby*) I am not suggesting that the social science methods—and that is really what we are talking about—contribute to a calculation of the value of something which by definition is unpredictable.

339. Thank you.

(*Professor Newby*) I am sorry, there is a "but". The social science methods have a lot to contribute to something which is at one remove from that, which is having to make very difficult and complex judgements of the costs and benefits of pursuing one particular area of scientific activity—not a particular piece of science, an area of scientific activity—as against another.

340. I would like to go on to something else where I can see there is direct possible applicability of the social sciences illustrated, of course, by the excellent work which SPRU has done. You commented yourself on the business; you used the words "peer review". We have a question of what might be called "grantmanship". When things are assessed by quality they are assessed by individuals sitting round a table, supposedly experts, small in number, otherwise they would never reach a decision, and with their own particular points of view which they bring to the table. Has any specific work been done by the ESRC or been contemplated which would enable the processes of choice themselves to be improved?

(*Professor Newby*) Yes, and I can send you further details in a written submission, if you wish. We have actually funded research on the peer review process and we have had researchers from the University of Bath sitting in on the peer review committees of other Research Councils. That process has been written up. First of all, though, let me say that I think the particular style of peer review which you describe relates to one of my sister councils, and that is not quite the way in which we operate at the ESRC. We run a system which goes well beyond the committee that is making these decisions. We use at the moment, I think I am right in saying, about 3,500 referees per annum. I would be the first to admit that the peer review system is highly fallible, and I would be the first to admit that another way of describing the peer review system is delivering yourself into the hands of your closest and deadliest rivals.

341. Occasionally friends?

(*Professor Newby*) Occasionally friends. It depends on the scale of resources which are on the table, I think. I can say that the evidence which comes from referees' reports has to be treated like any other piece of social science evidence; that is, it has to be interpreted, with judgements. So no one, least of all me, would claim that this system is infallible, but I think it is the least worst one we have. I think also in terms of this issue that we have referred to from time to time of authority and of building trust relationships between a funding body like my own and our community, it really is very important. We, on the other hand, have to exercise judgement over

[Lord Dainton *contd.*]

how those peer review assessments are used. We have to bear in mind the number of issues which have already been raised concerning market entry, concerning the status of the individuals who are applying, concerning the nature of the problem they wish to look at. We do not want a kind of "official" science in this country—we have seen what that produces elsewhere—and we do not want an "official" social science either. So I think that one does have to rely, at the end of the day, upon the judgement of experienced people in the community, but that judgement is, of course, tempered very extensively by the referees' reports they receive and the input, I have to say also, into that process of others including the customers.

342. May I pursue this and come to a practical issue facing us at this time. I accept entirely the internal expansionist forces of sciences which say what things we can do and the cost of doing them. Not knowing what the cost of one of those is when coming up against the other makes the choice all the more difficult. What I am worried about particularly in the social sciences is a point on which you touched, that is, libraries. I happen to be, and have been for years, Chairman of the Library Panel of LSE. What worries me is what is happening at present, namely, the transfer of funds from the block vote of universities to the Research Councils, which by definition does have a retarding effect on the development of young people in universities who are not yet at the point of what you would call market entry. Do you regard this transfer as having gone too far, far enough or not far enough? Do you think it is working well or is it having an adverse effect on the Science Base?

(*Professor Newby*) I would start by saying the situation we are in at the moment is inherently unstable and probably unsustainable. The second point I would make is that I would argue pragmatically from the very peculiar position of the social sciences that our interests in this regard at this time are not necessarily the same as those of the other Research Councils. Let me explain why, because the conclusion I am led to is that the transfer has not gone far enough. I suspect that may be a controversial view, so let me justify it. One of the issues which all the Research Councils are grappling with at the moment is how to sustain an internationally competitive Science Base, or knowledge base if we include the humanities and the social sciences in this, in the context of a higher education system which is moving (if I can put it this way) from an elite to a mass higher education system, and all the tensions we are all well aware of flow from that fact. It is a fact, sometimes perhaps an uncomfortable fact but it is a fact, that the bulk of this expansion is occurring on the recruitment of students in the social sciences and humanities.

343. That is why I asked.

(*Professor Newby*) Giving the falling unit of resource, this means that we as a Council have to be very wary of the erosion of our social science base because of the pressure that exists upon it from student numbers. We also have to try—we come back to back-seat driving again—to convince senior managements in 100 or more universities—although I think the number which really counts to us is much smaller than that—that they should seek to sustain excellence wherever they find it, including excellence in the social sciences, whatever the other pressures, and there are many pressures upon them. We have no purchase on the decision-making process internal to those universities, which they quite rightly jealously guard. So I am faced with a rather difficult dilemma and I put it at an extreme: do I stand idly by and watch the erosion of the social science research base in this country take place because of the pressures I have described or do I seek to intervene in some way in order to underpin the support of the social science research base so that we can support excellence in the social sciences? At the moment my policy is to engage in a dialogue with the vice-chancellors of the top 20 or so recipients of ESRC funds to see whether, in fact, we can achieve a sense of common purpose, and I am bringing them together round a dinner table only next week. But I do think that if that failed we would have to look again at the policy of putting all our money into universities, or the vast bulk of it.

344. If you were to do that, of course you would diminish the amount of money which universities might have for young people and the young entrants?

(*Professor Newby*) I absolutely accept that and I would not wish to do that, let me make that clear, but I think the other issue which relates to this, which comes back to the block grant to universities, is that while the block grant comes from the Department for Education into universities we have even less purchase on how it might be used when it arrives there. So at the moment from my particular perspective I would favour the further transfer of funds to the Research Councils, at least on the understanding, of course, that we would not hand it back on a project-by-project basis because that would indeed undermine the very issues you are raising, the issues of bringing on new people, allowing flexibility locally to take the best and brightest. If we, rather than DFE, were block-granting we would ensure the quality of social science in universities and we have no way of doing that.

345. Would you advocate formula funding?

(*Professor Newby*) That is a very difficult question to answer at this point in time when we are dealing with a rather divergent system of three funding councils and another body in Northern Ireland.

346. And with the unit of resource falling rapidly, particularly in your field, downwards?

(*Professor Newby*) I think downwards for reasons which are not altogether clear to me in terms of the Funding Councils' recent decisions in that matter.

Chairman

347. This is a very important point, especially since, although you say you were doubtful about it, you have actually made it one of your recommendations, recommendation No. 21, to the Chancellor of the Duchy where you say: "... we favour the transfer of the remaining research funds from the Funding Councils to the Research Councils." I was really struck by this, partly because, of course, you are almost alone in this, apart from the ABRC, which has an obvious interest in the matter,

[Chairman *contd.*]

but the other Research Councils tend to differ; secondly, because all your research is carried out in universities you do not need this funding for your own institutes; thirdly, because you have spoken clearly about recognising our difficulty in finding out how you set these priorities. The one thing we all come out in favour of is a plurality of funding methods, for obvious reasons. Everything is looked at at least twice and all this has disappeared to a large extent if you destroy our dual-funding system as far as research is concerned.

(*Professor Newby*) Yes. I am seeking to strengthen the dual-funding system. I hope I have made that clear by my other remarks. I would wish to strengthen it but I think it would be strengthened in our particular case by the allocations going down through my Council rather than down the DFE route.

348. But the donor would be the singular one of the Research Councils, would it not?

(*Professor Newby*) In my own case in the social sciences we are only responsible for about one-third of the research project income received by universities (in the new sense) in the social sciences, so there is a plurality of funding sources in the social sciences. The largest single funder of research projects in universities is Government departments, but there are many charitable organisations active in the social sciences as well. I am simply making the point that I think this transfer has raised some very interesting issues. We can no longer be just a funding agency in the narrow sense of the term. We have to have much greater responsibility for the future development of the social sciences base given these pressures of student numbers in that section.

349. This is talking about your own Research Council?

(*Professor Newby*) Yes.

350. But it is creating a lot of difficulties for others?

(*Professor Newby*) I quite understand that.

351. Are you going to stick with this with the Chancellor and say you do favour the transfer of all remaining funds for research from the universities? That is what you are saying?

(*Professor Newby*) Whilst this situation remains in this somewhat unstable state I have to say yes, but I also have to say that since the existing transfer is not yet complete, and will not be until 1995, I recognise at the moment the sensible thing to do is to go back to this question then and not before.

Lord Chorley

352. You are saying really that you are in a dilemma?

(*Professor Newby*) I am saying that, if the bulk of the expansion is to continue to ride on the backs of the social sciences and the humanities, and I have no direct purchase on the crucial decisions made on 105 senates on resource allocations...

Chairman

353. You say that *you* have not, but the universities surely are an alternative to you?

(*Professor Newby*) The various factors which go into that decision-making process on 105 different senates are many and varied, and they are ones in which my own Council's influence is itself variable. I am simply saying that it is an increasing dilemma to us. We shall have to wait and see how things go. Our current policy is to try to do it by opening up a dialogue with universities to make them aware of our need, as we would put it, to back excellence where they find it in the social sciences and not cram in more and more students in order to jeopardise that excellence. If the universities are seen by us not to respond, then clearly we shall have to think again about what to do.

Lord Dainton

354. The present situation, though, is that many universities are in a position that unless they increase their student roll they are not going to balance their books, are they?

(*Professor Newby*) I accept that. I said earlier that vice-chancellors have many pressures upon them, and I do understand that. My interest will be to protect the vitality of the social science research base in this country.

355. I come back, then, to the central issue of the priorities for what we might call the Science Base, including obviously the social sciences. The policy there is being made increasingly, and some would argue perhaps even more so, at the ABRC. Does it not strike you as absurd that the Funding Council has no representation on that body?

(*Professor Newby*) I think it is very unfortunate that the days when I and the Chairman of the SERC were ex officio members of the UGC have gone. Reciprocally, I find it disappointing that—it is a little more complicated these days, but as it would have been—the Chief Executive of the UFC is not an ex officio member of the ABRC.

356. I myself, of course, have lived through all these systems, as it were. I fail to see how either side can work without full and complete knowledge of the other side, if the dual system is to work harmoniously, given the changing circumstances and extra pressures you have described so vividly to us. One must see the effect on the institutions, just as the Research Councils must be made aware of what formula funding does in the way of, for example, extinguishing certain subjects.

(*Professor Newby*) This relationship has its ups and downs, as I am sure you are very well aware. I have to say that on a personal and informal level the relationship is excellent at the present time, notwithstanding the additional complication that has been introduced by our being in separate departments. However, it has had its ups and downs.

357. Yes indeed, but personal relationships are really no substitute for the fact of actually being present and taking corporate responsibility for

[Lord Dainton *contd.*]

decisions; there is a world of difference, I think you would agree?

(*Professor Newby*) I accept that.

Baroness Perry of Southwark

358. Let me go back to your wish to take over the funding from the Funding Council. Is not the flaw in that argument that you would have to use the same methodology—in other words, peer review—to provide some form of selective funding, unless you are telling us that if the Council had the power to fund you would be overriding some of the peer review decisions about the quality of departments and wishing to direct money specifically to the weaker departments?

(*Professor Newby*) No, I think that *if*—and there are a lot of "ifs" in this sentence—one is operating a formula-driven system, then clearly one needs to operate also something analogous to the research assessment exercise. I recognise that what I am saying would be regarded as a restriction on the ability of the managers of the universities to manage resources. I do recognise that, which is why at the moment I am watching and waiting to see whether the existing managers will use their resources in order not to jeopardise the social Science Base, given all the pressures which I have described. I think there are some real dilemmas there, as I say. However, as things stand at the moment, we know, on the basis of two years' experience now, that the largest single category of fees-only students have been in the social sciences. I know several departments where staff:student ratios have been going up at alarming rates which I do not think are sustainable without greater funds.

359. Is not this going to be sustained? The Government's changing direction in funding, announced last November, is going to make a very major impact into the number of fees-only students whom the universities are going to be able to take on in single subjects.

(*Professor Newby*) Let us wait and see. I accept that the restriction on band 1 fees is being introduced with that intention, and I accept that in some institutions that will have that effect. I go back to my research background and I think of the analogy of the reaction of farmers to falling crop prices; they actually farmed more intensively in order to retain revenue. I think that some institutions will be tempted down that road. The second point is the overwhelming bulk of student demand. This comes back to the fundamental issue for your Lordships. At the moment there are signs that the bulk of the demand for social sciences coming from high-quality students is going up appreciably; that for the foreseeable future, certainly long enough for all these changes to have overtaken the universities, the bulk of the demand—not all of it, of course, but the bulk of it—is coming from the social sciences and the humanities. So I have a very particular issue which greatly concerns me and my Council at the present time, which is perhaps a little different to that of the other Research Councils.

Chairman

360. You talked about your investment in technology foresight at SPRU. Do you have any other such investments apart from SPRU?

(*Professor Newby*) Yes. I can send details to you afterwards, if you wish. We have quite a number of major investments. We have a major programme of information and communication technologies which involve three centres around the country, one of which actually is a sub-set of SPRU, as it happens. We have work on science policy through our funding of the Science Policy Support Group in London and also through the assistance we have given to the programme on the public understanding of science which we have run in recent years and which will be coming shortly to an end. Also I want to stress this. I think that our funding of work in the whole area of industrial competitiveness, the management of innovation, technological change, is as relevant to these issues as these more easily apparent areas.

361. Yes, but there is no other independent unit, so to speak, like SPRU?

(*Professor Newby*) SPRU is part of the University of Sussex, I should say, and we have a number of other centres which, yes, do involve work in this area. I can send you the details afterwards.

362. Thank you, it would be useful if you would. Also we would like to have that peer review survey which you mentioned.

(*Professor Newby*) Yes, I will let you have that.

363. Finally, we have had a number of discussions with your colleagues about the future of ACOST, ABRC and OST. Most of them say, "We anyway should remain, and the other ones should go because now we have OST we have too many." You, I think, are the only one who has come out clearly in favour of all three being retained, albeit in a slightly different form, "revamped" or "at arm's length from Government" . With OST coming in, is there not a case for some simplification of these quangos?

(*Professor Newby*) I think we have been arguing for the retention of the functions, not necessarily the retention of the bodies in absolute terms.

364. I did not see very much difference. ACOST looked pretty much the same and the ABRC would be more advisory and at arm's length from Government, but otherwise it looked very much the story as before.

(*Professor Newby*) Let me start with what is currently ACOST.

365. Lord Tombs would be very interested in what you say should happen to ACOST!

Lord Tombs

366. Not really.

(*Professor Newby*) I am choosing my words very carefully. I think ACOST's prime role in the future, I would argue, is to be linked in a much more organic and systematic way to this business of technology foresight that we have talked about earlier. I think ACOST has gone some way down that road but not, I think, in quite as systematic a fashion as a number of our major industrial competitors have. The ABRC issue is rather a different one which relates to the

[Lord Tombs *contd.*]

extent to which one would wish to sustain the Haldane principle and see the activities of the Research Councils as being—not necessarily directly—associated with ministerial decisions or not. To put it somewhat rhetorically, were there not to be some mechanism interposed between ministers and ourselves then clearly the relevant minister or ministers would have to take responsibility for the closure of a particular research centre or take the decision on particular scientific priorities. We have for a long time had a principle in this country that ministers do not involve themselves at that level in that kind of decision. Whether or not, therefore, the mechanism should be at arm's length from OST—

367. That was your expression.

(*Professor Newby*)—or whether it should be incorporated into the OST structure I have no strong views about. I think that is really a matter which no doubt the White Paper will address.

368. Thank you. Mr Caswill, is there anything you feel has been said that should not have been said or has not been said that should have been?

(*Mr Caswill*) No, everything is fine.

Chairman] Thank you both very much for coming and for answering our questions so fully.

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HOUSE OF LORDS SESSION 1992-93

MINUTES OF EVIDENCE
TAKEN BEFORE

THE SELECT COMMITTEE ON SCIENCE AND TECHNOLOGY

SUB-COMMITTEE I PRIORITIES FOR THE SCIENCE BASE

Wednesday 12 May 1993

NATURAL ENVIRONMENT RESEARCH COUNCIL

Professor J L Knill

AGRICULTURAL AND FOOD RESEARCH COUNCIL

Professor T L Blundell and Professor J R Krebs

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WEDNESDAY 12 MAY 1993

Present:

Butterworth, L.	Perry of Southwark, B.
Chorley, L.	Porter of Luddenham, L.
Dainton, L.	Selborne, E.
Dean of Beswick, L.	Tombs, L.
Flowers, L. (Chairman)	

Examination of witness

PROFESSOR J L KNILL, FEng, Chairman, Natural Environmental Research Council, was called in and examined.

Chairman

369. Professor Knill, would you like to say a word by way of introduction or shall we charge straight in?

(*Professor Knill*) My Lord Chairman, I think we can charge straight in.

370. May I then ask you to say a few words about whether you have priorities, whether you have a mission and to what extent the priorities reflect the mission?

A. We have indeed, my Lord Chairman. Our mission is essentially to pursue environmental science. It is presented in rather more detail in our corporate plan where we relate it very clearly to the pursuance of excellent basic and strategic research in environmental sciences through our institutes and through higher education, to training, to survey and monitoring, to the support of the development of Government's regulatory programme, to the development of technology, to the provision of operational facilities in the support of environmental research and so forth, so that our priorities are strictly related to the environmental sciences.

371. And wealth creation does not enter into it?

A. Wealth creation enters into it because, of course, the environmental sciences are entirely applicable and wealth creation is pervasive through it. Wealth creation is both positive and negative in the sense that the Natural Environment Research Council is concerned with the finding of resources, for example, the finding of mineral resources and hydrocarbons in the sea through the British Geological Survey; it is also concerned with issues relating to the loss of resource, in other words, the failure of industry to operate properly causing pollution and causing loss of land through contamination and so forth. Therefore, we really have a very pervasive interest in all aspects of wealth creation both in terms of actually creating wealth and ensuring that wealth is not lost and assisting in the development of governmental policy so that regulatory frameworks are not expensive as far as their cost to industry is concerned.

372. To what extent are your priorities your own, devoted to your view of your subject, and to what extent are they dictated or encouraged by government departments or by industries which operate in your area and so on? Do you co-operate with them in the creation of your own sense of priorities?

A. The environment does not operate in an ivory tower. Therefore, our priorities have to be based on contacts both nationally and internationally with all organisations and individuals that are relevant. But there is one characteristic of the Natural Environment Research Council which is important, that is to say, two of our institutes, the British Antarctic Survey and the British Geological Survey, have had their specific missions determined by Government. We operate both those organisations in relation to the wishes of Government and they make up about 30 per cent of our spend. We have interactions through our Council, our Committees, by specialist groups that we establish, by workshops, by town meetings, by visits overseas, with other scientists in institutes and in universities, in industry, in other governments, so we have a very pervasive involvement and a very considerable knowledge not only of what is happening in this country but of what is happening in Europe and overseas generally. For example, my Lord Chairman, I was in Spain last week where I spent a day in Madrid looking at the science structure in Spain and then two days in Seville where I was attending a conference on biodiversity. I think that it is important for all officers within NERC who are concerned with developing priorities to familiarise themselves very closely with what is happening on a national scale and on an international scale.

373. Thank you. I wonder whether you may be able to say a few more words about how your priorities emerged and, when they have emerged, what you do to give effect to them?

A. The process, my Lord Chairman, is essentially a bottom up one, but it is not completely bottom up in that we have an annual round whereby our Science Committees re-examine their portfolio, look forward to new opportunities that exist, review them over the summer period by specialist working groups and so forth, reconsider the priorities in the autumn and then take that forward on an annual cycle. The information comes forward in a wide variety of ways: it may be an individual contact with a member of the Committee or a submission that comes from outside. There are examples like that that I can quote where we have major programmes that are entirely bottom-up derived. That then is the annual process. We have a longer process which is a five year process where we published in 1988-89: our six science strategies. These are now being revised and we have held the first round of Science Committee meetings where we have

[Chairman *contd.*]

looked at the overview as to how they should develop. The developed drafts will come to our Science Committees in the autumn and they will be published in 1994. However, there has to be a top down procedure as well in the sense that from time to time it is quite clear that individual areas are being missed and it is necessary for us to initiate programmes in particular areas. This requires myself or senior officers to say, "There will be a town meeting", where we will examine a particular subject because we feel that it is not developing early enough on a bottom up basis. As part of the annual Forward Look Programme we have, of course, discussions with fellow Research Councils and we have a very effective relationship with them. A year ago, for example, we held a two day seminar with the Medical Research Council, with whom we had never had any collaborative research, looking at environmental and medical research opportunities, bringing together their community and our community. From that spun up two areas, one of which was in UVB and the other of which was in asthma. That I think is an example of the way in which we work very hard to ensure we are encouraging opportunities that exist in the other science areas.

Lord Porter of Luddenham

374. Professor Knill, in answer to the chairman's question you said very forcibly that wealth creation certainly did come into your method of assessing priorities. What other important factors are there apart from wealth creation?

A. My Lord Chairman, in terms of assessment the most important is quality of science. My personal view is that wealth creation has been given too high a profile within the last few months. It is one of the factors; but beyond wealth creation is the quality of the environment and the quality of life. I should give those equal weight. The driving factor, however, in a selection of science priorities within the Natural Environment Research Council is excellence of the science.

375. Of course, the environment and so on are also applications of the Research Councils' choices, are they not? You have told us one, that is, the selection of priorities on the basis of good science?

A. Yes.

376. Do you have any other ways of assessing priorities, the subjects, apart from good science?

A. Yes, my Lord Chairman, broad need, for example, the research that we have carried out in relation to ozone depletion. The British Antarctic Survey discovered the ozone hole in 1982 in the Antarctic, it was published in Nature in 1985. At much the same time we had a higher education community in the meteorological area who developed a programme concerned with global atmospheric modelling which was based on Reading University but was developed over a number of centres. We put a further tranche of money into that three years ago which was related to ozone depletion but centring on using their modelling while in the Arctic environment. This essentially was good science; it was also good science that was very important as far as this country and Europe were concerned. Therefore, what we are looking for all the time is wider opportunities to exploit excellent science and see where that science can be of value in solving practical problems.

377. All the examples that you have given have obvious, fairly near applications?

A. Yes.

378. Would you say that that is a characteristic of the Natural Environment Research Council? It is not, of course, of some of the other Research Councils. Some are very long term and have no obvious applications at all. If so, Professor Knill, it would make your task rather easier perhaps than that of the other Research Councils, that is, the task of selection of priorities?

A. It is an interesting point, of course, because it relates to the way in which survey and monitoring is an important part of environmental research. We are interested in the changes that occur in the environment because they indicate processes, both physical processes and biological processes, that are taking place which one may not be aware of. Therefore, survey and monitoring is one way in which we can enter into finding areas of basic science that have not been exploited before. When I became chairman of the Natural Environment Research Council it is fair to say that survey and monitoring were deemed to be equivalent to stamp collecting and I think that in fact there has been quite a dramatic change and recognition of its importance. But there is also a significant amount of basic research which is actually being carried out within the Natural Environment Research Council. Much of our work, for example, in population biology has been of that kind where we have been looking at populations of creatures, insects, birds, which now, of course, has become of considerable importance. Another illustration of that work, which is decades long and started with Nature Conservancy as was, is that one of our research stations is looking particularly at the population biology of starlings, specifically in relation to the control of them as pests. Therefore, there is in much environmental research a very long history of collection of information and data which then requires exploitation into basic research from which one can then see a strategic application.

Lord Tombs

379. My Lord Chairman, Lord Porter raised the question of wealth creation. May I touch on what I might call wealth conservation, that is, the cost of complying with various perceived aims. There is clearly an area here where detection, the setting of limits, cost effective remedial measures, interact between you, the Medical Research Council and the Economic Social Research Council. Can you describe the activities that you have in this area and how that affects your priority setting?

A. My Lord Chairman, the example that I should select would be our work in relation to the control of nitrates and their use in agriculture. Our interface is not with our fellow Research Councils but out there with the National Rivers Authority. We were concerned with the real world and some years ago I remember giving evidence here where we were

[Lord Tombs *contd.*]

concerned with nitrate composition of groundwaters and the European Community regulations, which I think medical scientists in this country regard as too stringent as far as nitrates are concerned. This I think is an area where there was unity in the scientific sphere. We are very much concerned with assisting industry, first, directly in helping industry which is concerned with certain problems of this kind. Here, an example would be the work which the British Geological Survey is doing for Nirex which is a very major programme at present; or in assisting, for example, the Department of the Environment where they may be looking at issues in relation to wildlife diseases where one can see the potential tip of an iceberg which does need investigation and progressive exploitation. We are therefore very closely in touch, looking at areas where there may be additional costs imposed on industry resulting from either pollution defined in the broadest sense or over-stringent regulation.

380. Does the Natural Environment Research Council take the lead in such issues as nitrates rather than, let us say, the Agricultural and Food Research Council or the Medical Research Council?

A. We should take the lead in certain issues relating to it. In the case of nitrates, we had been carrying out research on nitrates for several years before in fact it came into fashion to study it, so we had very considerable expertise and, of course, a very considerable data base of information. That would be how it happened in the case of nitrates, my Lord Chairman.

381. Finally, how does this general consideration find its way into your priority setting? From where does the spur come?

A. Much of the work that I am describing, of course, is in relation to commissioned research which we actually carry out for industry. The example of wildlife diseases is a good one. There was a recognition about four, five years ago that there is an issue developing in relation to wildlife diseases on quite a broad front and we were given a very small contract by the Department of the Environment which clearly established that the issue was much larger than had been appreciated. The proposal was then created within Council to fund what we call a special topic. We put 2.5 per cent of our spend into special topics. This proposal won competitively against other areas passing through our Committees, and then to Council. It became one of the special topic bids for that year, and the spend would be something in the order of half a million pounds or £600,000 over three years. This then is a good example of an initial idea coming out of the Department of the Environment which was taken on board by us and for which we used science budget funds. Then, of course, if we saw specific issues coming out in that special topic, because we should have the Department of the Environment in partnership with us on the strength of it, we should be looking for bolt-on funds from that source or from other sources which we saw as valuable at that stage.

Lord Dainton

382. Professor Knill, I am very interested in what you wrote in your document about balance. There are times when you are called upon to make judgments in priorities when you are setting off, if you like, excellence on the one hand and utility on the other, or potential utility. Do you have any special mechanism which differs from the other research councils in this regard? I am also very interested in the fact that even though you are called the Natural Environment Research Council this really transcends any kind of national boundary—it might be International Environment Research Council in one sense. Here there is a lot of money floating round internationally. Sometimes this Government puts its hand into its pocket and produces a Darwin initiative or whatever which must affect what goes on with you. In particular I think of the Global Environment Facility where there seems to be a tremendous sum of money. How do you manage to keep your own work in balance with what goes on internationally, how can you influence what goes on internationally and keep it on a sensible route? What goes on internationally must affect some of your own priorities?

A. In relation to the general answer, my Lord Chairman, I think that my answer is rather similar probably to that of my fellow Research Councils, that is to say, historical precedent is the starting point. But, as a Council, we recycle funds on an annual basis and over the next three financial years about 40 per cent of our science funds will be recycled, in other words, they will come up for reallocation to new areas of science.

383. What proportion of your total budget would that be, 40 per cent of your science?

A. I am excluding the British Antarctic Survey and the British Geological Survey, so it is 40 per cent of 70 per cent of the total; and from that, of course, I should be excluding the ring fenced funds that go to universities in terms of research grants.[1] First of all, we have a recycling process; and secondly, we will want to change the priorities. Some very good examples in very recent years are, first of all, the atmospheric sciences. We have taken a conscious initiative to increase the spend in those. This has been a continuous growth. We have made exactly the same decision as far as the Arctic is concerned. We have recognised the increased requirement for the Natural Environment Research Council to be involved in the development of various forms of environmental modelling which commonly require super computers so that is requiring a major change, as is the handling of data, particularly satellite derived data. All of these are areas which it is fair to say within the last three to four years have dramatically begun to change at the margin for prioritisation within

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[1] *Note from witness:* There are various ways that the sums available for recycling can be presented as a percentage of all or part of the Science Budget. In our Forward Look submission to ABRC this year we used the formula that: "Over the three years 1994/95 to 1996/97 approximately 40 per cent of NERC direct expenditure on science, that is the total Science Budget less expenditure on Headquarters, pensions and major capital, would be recycled in terms of our existing activities and projects."

[Lord Dainton *contd.*]

Council. I should also make another point, my Lord Chairman, which is related not to science but to process. When I became chairman of the Natural Environment Research Council I was very conscious of the tension between our institutes and universities in terms of resources. We have developed what we call community research projects, which are joint projects that provide for funding of both and collaboration between both. Much of the resource that is available is, in fact, competed for by both communities. Commonly they form teams together and compete together against one another, but it has been a very effective way of producing I think added value and certainly best value for money in bringing those communities together. Not only have we changed the balance of science but we have changed the balance in the way that the money goes to different science communities to make it more effective.

384. Does this mean that those people in your institution in a sense are internal bidders for monies as higher education institutes are external bidders for monies and they may be in the same area of study and come together?

A. Effectively, my Lord Chairman, yes, but it would be a pot that they would all be competing for instead of competing for separate pots.

385. Do you think that that has had any effect and, if so, how extensive has it been?

A. It has had a quite dramatic effect and a very beneficial one particularly because it has enhanced interdisciplinarity. It has brought together sciences which have worked in very different scientific areas and did not really even meet one another. Perhaps I may illustrate this in relation to one of our latest community projects, which is the land/ocean interaction study (LOIS). You can imagine all the disciplines—atmospheric scientists, oceanographers, geomorphologists, botanists. It is very rarely that you can imagine a scientific opportunity would get a group of those individuals together to work together to achieve scientific results. That is what the objective of the community-wide research projects is. Therefore, the change in the mechanisms is also an important way in which we are developing a change in the balance in the way that the Council works.

Chairman

386. Of this money what proportion goes to universities and what to your institutes?

A. Out of the community research project there would probably be one third of the money that would go to the higher education area and about one third or probably a bit more to institutes and the remainder would go to facilities because we should have to introduce costs of ships and costs of facilities and so on.

Lord Dainton

387. Do you also think that you can perceive an increase in the quality of the work done because their perceptions of what they are about have been sharpened?

A. A very considerable increase in quality because we go through an iterative process. When we decide in Council that we wish actually to develop one of these community research projects we create a scientific steering group who create a science plan which is then published. Then we acquire the funds either by reallocation within the Council or by a successful forward look bid through the ABRC. We then in fact develop from that an implementation plan which takes the science plan and adds money to it and then allocates the money in the various ways into the system in terms of the balance between the sciences. If I may take the land-ocean interaction study (LOIS) as an example, the quality of science has in fact driven the way in which the money is lying, in other words, whether the money has gone to the shore, to shallow water or to land or to river or to estuary. It is the quality of science that has driven the balance of money that has come out. We have not said that there will be 10 per cent of the money for estuaries. It is the quality of the proposals that has determined the percentage.

388. So in a sense the actual scientists themselves out of their experience are helping to shape your priorities?

A. They are in fact shaping the priorities through quality. Now if we found in a programme of that kind that in a key area we were not actually getting the science carried out then we might have to act, but this has not happened so far because there are enough environmental scientsts of good quality in this country to be able to compete to cover the whole area. However, my Lord Chairman, I was distracted again from the second question, which was related more to the international area. Probably more so than in any other discipline I think that in environmental sciences there are excellent collaborations. First of all this is through the World Climate Research Programme; and secondly, through the International Geosphere/Biosphere Programme. Both these, of course, are major international projects that we take part in, that is, we take part on an à la carte basis, in other words, we decide which we wish to be part of, we contribute significantly to the running of the programmes and we will provide from time to time offices in this country in order to help support these programmes. The new chairman of the International Geosphere/Biosphere Programme, may I say, is Professor Peter Liss of the University of East Anglia, who is a member of my Council. I think that is a signal honour for Professor Liss and also for the United Kingdom that he has been identified for a major programme of this kind. Thus we take an active role in those programmes, but we operate on an à la carte basis where we believe that our science is at the leading edge, for example, in physical oceanography or plankton population mechanics where we will go forward enthusiastically. As far as other areas are concerned we will effectively realise that we are not in the first league internationally and take a much less significant role.

389. If I may, my Lord Chairman, I just want to bring out something in which I know the Earl of Selborne is particularly interested also, that is, the large amount of money that is sloshing around in the Global Environment Fund. Does that affect you?

A. No.

[Lord Dainton *contd.*]

390. Why is that?
A. Because it is not primarily related to the kind of research that we do.

391. Is it peripheral?
A. It is mainly related to research that is taking place in developing countries from which we might get spin-off, but not directly.

392. In relation to global biodiversity, in which you have an interest?
A. Yes, but it would be indirect rather than direct. It is rather like the Darwin Initiative, although we should contribute very enthusiastically to ensuring that it works successfully.

Baroness Perry of Southwark

393. My Lord Chairman, I should like to take Professor Knill back to one of the priority issues that I do not see emerging yet from the answers. Professor Knill, you have nailed your colours, I think, both in what you have said this afternoon and in your paper on the White Paper to interdisciplinarity?
A. Yes.

394. The whole Council is obviously in a field where interdisciplinarity is crucial to the achievement of the kind of schemes that you pursue. Do you also in your determining of priorities pay attention to the needs of the individual sciences for strengthening? Perhaps I may here give you an analogy. I have a vision of people building the top half of the bridge which links with other disciplines so firmly that they might be in danger of forgetting the pillars on which the bridge rests, which are the individual disciplines. Some of the disciplines that you support—and I think of oceanography as an example, my Lord Chairman—would be very unlikely to get funds from any other Research Councils than yours. Do you occasionally give priority to the simple development of one of the individual science disciplines in your field?
A. Yes, to a degree. I can take a number of examples, but a good example would be oceanography where it is very important to have a flow of physicists into oceanography, particularly for modelling. I can introduce meteorology as well, where students do not flow naturally from the undergraduate schools. What we do, my Lord Chairman, is to have initiatives in relation to postgraduate studentships which encourage physicists to move into Masters courses or PhD courses in oceanography and meteorology, specifically to enhance the numbers in that area. In fact, my Council has been discussing precisely this matter at the present moment because we are concerned about the impact of four year degree courses on tending to move scientists who are in a particular discipline away from interdisciplinary options. Within my own experience at Imperial College I ran the Department of Geology where we taught third year chemists and physicists, and we taught them geochemistry and geophysics. We regarded this in the Department of Geology as an important way that one would encourage not only interdisciplinarity but also enhance career development. As an illustration in a very different field, we developed over a period of years, primarily funded by the British Geological Survey, an ICPMS. This, my Lord Chairman, is an instrument which is used for measuring very small quantities of elements in very large numbers; that particular development wons the Queen's Award for Technology. Therefore, we are embedding ourselves scientifically in those areas and in those disciplines where we regard it as important. Another mechanism that we use would be to put a unit in a university which was tied to a particular department or which was tied to a group of departments where we feel that they could draw upon and interact with their individual disciplines. An illustration here, my Lord Chairman, would be a unit that we have at Reading University which is concerned with thematic information systems, and that interacts with the Departments of Geology, of Geography, of Meteorology, and takes advantage of those disciplines to create an interdisciplinary centre that will help to produce solutions to interdisciplinary problems. However, we really are very conscious of not wanting to separate ourselves out from the sciences. We do in fact fund a certain amount of research into physics and chemistry in such departments. We have funded research in ice at Bristol University, Department of Physics as an illustration. There is therefore a small spend by the Natural Environment Research Council in non-environmental science departments, but it is no more than about 5 per cent.

Lord Chorley

395. I am a member of Professor Knill's Council. I have two questions, my Lord Chairman, and I will take them separately. As an illustration of the co-operative side of developing work for the Natural Environment Research Council it seems to me that it might be interesting to know something about the initiative with Southampton University on oceanography because that does seem to be an excellent example of co-operation. Coupled with that is how that affects the setting of priorities or offers an example of setting priorities.
A. My Lord Chairman, I think that I really have to blame your Lordships' House because, of course, the Southampton centre was originally proposed by a Sub-Committee of this Committee chaired by Lord Gregson, and the suggestion at that time was that there should be a drawing together of oceanography into particular centres. The suggestion was made that the Institute of Oceanographic Sciences Laboratory at Wormley near Godalming should merge on a university campus. We took that idea, which was published in the middle of the 1980s, and at that time the University Grants Committee, of course, decided that oceanography would be at two centres, at Bangor and at Southampton. We explored the two possibilities and Southampton was clearly the more sensible. There was by chance a site available in Southampton docks, at Empress dock, which would provide us with water access which would enable us to bring our Research Vessel Services from Barry in South Wales to Southampton. That was the germ of the idea. We then sought the funds both through ABRC and through the Universities Funding Council. We won the funds and therefore we have a joint venture between ourselves and the university

[Lord Chorley *contd.*]

where our Institute of Oceanographic Sciences, our Research Vessel Services, and two departments and one institute of the university merge on the site in Southampton. Construction is under way and it should be effectively open within two years' time. That, I think, my Lord Chairman, is merely a change in as it were location. The consequence, of course, is going to be the value added in terms of bolt-on funds which will come from industry choosing to site itself in Ocean Village, which is next door. We already have considerable expressions of interest in that and we see that the secondary benefits of that initiative are going to be very considerable.

396. The commissioning of research is clearly very important to the Natural Environment Research Council—I should guess that it is probably more important to NERC than in the case of all the other Research Councils. Historically I suppose that it has something to do with the 1980s when science budget funds were very short and it was necessary to maintain income. Does that have a distorting effect perhaps at an institute level on priority setting or activity; and, if so, how does it?

A. My Lord Chairman, I think that it was really the Rothschild transfer that put this change in serious mode as far as the Natural Environment Research Council is concerned in that we had to bid for funds that previously were part of our budget. We were the Council that was most seriously affected by the Rothschild transfer and ever since that time there has been a growing commissioned research portfolio within NERC. This year it will be in excess of £40 million so it is an important aspect of our work. In part, of course, it is research that we carry out because it provides value added to science budget research that we are carrying out at the present time. As far as the British Geological Survey is concerned it is part of the way in which in the long-term Government sees the British Geological Survey funding itself and funding the long-term mapping of the United Kingdom. The difficulty that I think our institute directors face are those of short termism, that is, that they have to operate with very many contracts, particularly from government departments, which are related to essentially policy driven questions which are on a three to six month basis. Therefore, they are continually looking for small contracts. We should far rather see from government departments a wider portfolio of activity where we have greater guarantee of funding over a longer period and this would certainly introduce much more stability within our institutes. At the present moment, however, the average income of our institutes is between 50 and 65 per cent from commissioned research.

397. May I ask whether this gives rise to distortions? Does your having to go out and get this £40 million to £50 million a year result in particular institutes' science base getting distorted?

A. To a degree, my Lord Chairman, I think yes in the sense that to maintain expertise it may be necessary for a particular institute to carry out more bread and butter work than one actually wanted to in one particular year, but the next year the situation may be totally different. I should not say that there was any severe distortion, but there will be distortions from time to time. The country retains a resource base which, of course, is available if it is needed when issues arise. I can refer briefly, for example, to the Braer oil slick disaster where the input of the Natural Environment Research Council instantaneously provided support on modelling in relation to the movement of the oil slick. Only a matter of a few weeks later it was NERC, although not much publicity was given to it, which shepherded the whales out of the bay in the Shetland Islands.

Lord Dainton

398. It could therefore be said that your commissioned research in a sense sets the priority for some of your spend?

A. No.

399. Oh?

A. I think that the commissioned research may identify exciting areas of science that need further exploitation and the wildlife diseases example is a good one as far as that is concerned, but our objective would be to seek spend which was a bolt on to our science budget objectives. Perhaps I may give an example from the Overseas Development Administration, and that is our largest client, I should say—it is often assumed to be the Department of the Environment, but in fact it is the Overseas Development Administration that is our largest client. We do a lot of work both in the Sahel and in Amazonia in relation to energy and water transfer under those conditions. This is basic research, yet it is funded by the Overseas Development Administration, and of course it has applications as far as the sustainability of vegetation under both those environments is concerned. Now, of course, we are looking at that research which has been going on for a decade. When we look at it in the present circumstances of interest in global warming, it is seen to be highly relevant and important research, so this is the web that we are working with the whole time.

400. But you there chose an example which seems to me at one end of the scale of length. The Overseas Development Administration has a long time horizon so that the other things in commissioned research you were saying would be quite short—six months?

A. The Overseas Development Administration has a long time horizon because there is less of an immediacy on policy decisions which are related to the United Kingdom, and it is the policy driven research that we find to be becoming increasingly short term in its view.

401. Is that a source of worry to you?

A. Yes, my Lord Chairman, it is a concern to the institute directors because they are continually looking for contracts. If contracts were on a longer time scale, it means that there is a greater certainty of funds and a greater certainty of direction as far as the particular area of research is concerned.

402. Do you make a surcharge on those contracts to enable you to keep the infrastructure in being?

A. They are normally at full economic cost.

403. Which includes a surcharge?

A. It will be a full economic cost.

[Lord Dainton *contd.*]

404. We all know how those contracts can be drawn up, do we not!

A. You can be assured that the way they are drawn up we do not lose and there may be profit elements.

Chairman

405. A little while ago you said that you thought perhaps there had been too much emphasis on wealth creation from basic research. Sir Mark Richmond when he came to us a few weeks ago implied rather the opposite, namely, that the Science and Engineering Research Council was going to go for wealth creation and would put its money wherever appropriate research was to be found, not necessarily in universities or in institutes—possibly in industry or wherever. I just wondered whether there is a difference of view between you and whether you would like to say a word about that?

A. My Lord Chairman, I feel that NERC's sails are well set and they do not need trimming under this changed situation because I think that our portfolio, and our long term portfolio, demonstrates that we are involved in wealth creation and with the quality of life. This has become an issue within the last few months and therefore in the way that ABRC looks at priorities, for example, it becomes a new factor in the prioritisation process.

Earl of Selborne

406. My Lord Chairman, I want to explore with Professor Knill to what extent, if at all, intergovernmental agreements ever require the Natural Environment Research Council if not to trim their sails, at least to take account of commitments that governments have entered into. Let me take as an example the earth summit at Rio where this country signed the climate change convention, the biodiversity convention, from which would arise a requirement to submit national action plans. It is reasonable to assume that from those national action plans will come a suggestion perhaps from the Chief Scientific Adviser or from the departments involved that there should be an increased contribution to the World Climate Research Programme or a different emphasis. Would you expect that to be the case, Professor Knill? Would you expect governments to try to influence your determination of priorities in order to meet such an international obligation?

A. Not in the direct sense, my Lord Chairman, no. I believe that they do explicitly in the case of the British Antarctic Survey and in the case of the British Geological Survey, but my experience is certainly that there is no direct influence. I think that there is, of course, a lot of discussion in Council with the members who come from government departments, with members from government departments who are assessors on Committees and so forth. However, in a sense I think that we are always looking at what we regard as being the priorities for the future. There is, I think, a good example of this, my Lord Chairman. When I became chairman—in fact, a few days before I became chairman—Lady Thatcher gave her well known speech to the Royal Society, and I think that what was a great surprise to both ministers and officials was the fact that the Natural Environment Research Council had in fact in place a global change research programme, not only under way but also planned, and it was a pleasant surprise. I think that our objectives always are to be rather ahead of the game in terms of what we are thinking about and what we are developing at any particular time. It is hoped therefore that our priorities to a certain extent shape what governmental priorities might be.

407. May I therefore assume from that that you would see the international obligation that we have to produce national action plans as an opportunity for you to attract further funding?

A. My Lord Chairman, I should very much hope that the Joint Nature Conservation Committee in which I declare an interest should receive such funds because it seems to fall very squarely within its remit rather than the Natural Environment Research Council.

408. Thank you for that plug! However, I was talking about climate change as much as biodiversity.

A. Perhaps I may take an example which is related to climate change which is relevant because it is under discussion at the moment, and this is the Global Climate Observation System, called GCOS. The view of the Natural Environment Research Council is that GCOS, which is very important in terms of the monitoring and observation of climate change, is essentially related to operation: it is an operational programme. There may be a research content relating to the creation of the programme, but it is not for NERC. If in fact a GCOS was to be constructed then in fact we should be very pleased to carry out the research contracts as part of GCOS to enable it to be set up effectively, but we do draw rather firm lines between what we regard as an operational programme—and GCOS is a good one in the climate change area—and a research programme.

Chairman

409. Professor Knill, you said that you stay ahead of the game. How do you ensure that that is the case, how do you know that you are not just reflecting current fashion? Do you consciously enter into some sort of forecasting exercise and, if so, with whom?

A. With ourselves and with others, my Lord Chairman, and if I may refer to the Cabinet Office Research Foresight document which was published in March there are words that refer to the Natural Environment Research Council in that document, under I think section 5.2, which commend our approach to research foresight. I think that is an independent view of the way that my Council looks at research foresight and handles it in relation to the other research councils. Therefore, in fact, by having a very international approach in the way that we operate—our senior staff travel extensively internationally in terms of seeing other scientists and attending meetings—we have a very major overview on what is happening on a world wide basis. We really believe that the very best ideas do come to our Committees. I have very considerable confidence in Council.

[Chairman *contd.*]

410. So you bring home the latest fashions from Paris as well as indulging in ones from London?
A. And we also, my Lord Chairman, trawl up the old fashions like taxonomy where we feel that there is something to be said.

411. When prodded by us.
A. Touché!

412. I am aware of that document. I just wondered whether you could say a very few words about how you go about trying to foresee the future as far as the priorities are concerned. Can you say what you actually do?
A. Our senior officers, our staff, members of universities, travel the world. We have an annual system whereby we look at priorities through our Committee structure. This is a very serious process and it involves significant discussion.

413. And what changes have taken place as a result in the last two to three years, Professor Knill?
A. The ones to which I referred, the increase of funding in the atmospheric sciences, the increase of funding in terms of the Arctic, a move towards more expenditure as far as modelling is concerned, a greater interest in the creation of protocols for the handling of data and networking, so that there is a series of developments taking place in the Council as a result of that.

414. And you have dropped something to make way for these new things?
A. Yes, because we are recycling our funds. For example, we paid for the taxonomy initiative by closing down a targeted programme. We were putting larger numbers of research students into particular areas; in one programme, for example, in the earth sciences we were looking for earth scientists entirely out of non-geology departments, in other words, chemistry departments, physics departments, mathematics departments. We ran that for three years, we closed it down and then we started the taxonomy initiative. We therefore have a quite ruthless recycling of money on an annual and a three yearly basis.

Lord Dainton

415. One thing that troubles me slightly is that in your letter to Mr Waldegrave about your future there is a section 19 called National Structures for S&T Advice and Support which seems to me to read as if you were discontented with the way in which you were not able really to set your own priorities as you would have liked to have done because of a lack of communication, to say the least, at the interface and wanting to set up other structures. Do you remember that?
A. I do not remember that section, my Lord Chairman, no.

416. It says that "action is needed to ensure close coordination at the interface" with Research Councils and the Higher Education Funding Councils. Do you see that as a real lack?
A. Oh, yes, and I hope that I have illustrated that in relation to short termism through departmentally run commissioned programmes. As far as other research councils are concerned I think that we have a very effective interface. I have talked about, for example, where we created a workshop with the Medical Research Council. We have joint programmes with the AFRC and with SERC at the present time and where there is an interface that involves continuous joint funding we often have a committee. There is, for example, a joint working group in atmospheric sciences between ourselves and SERC which is very much concerned with watching policy in both directions. It is however something that must be watched the whole time because it is very easy for a committee of that kind to just stultify. It needs to be monitored very carefully.

417. Do you mean by somebody else rather than the Research Councils?
A. No, the Research Council itself because it is part of the way that we operate. I think that we ourselves in part need to monitor the way that it operates, but in fairness I think that the ABRC does. If I may illustrate, there is the ABRC Interagency Committee on Marine Science and Technology which is taking an overview not only of Research Council sponsored work in science and technology but also the interests of departments. The ABRC therefore has an interest in such areas at the same time.

Chairman

418. Would you say that the ABRC has a very extensive role to play in priority setting as it affects you or is it just very occasional?
A. As far as we are concerned, my Lord Chairman, as far as specific priority setting is concerned, the primary impact is through the recommendations that are made in respect of additional funding. That is the main area where the ABRC does affect the priorities that the Natural Environment Research Council at the end of the day has.

Lord Chorley

419. You told us about the competitive bidding that you introduced between the universities and the institutes and you told us that the result of that was about 50/50 between the two?
A. Yes.

420. My question is, did that actually produce any change and, if so, what?
A. My Lord Chairman, I think that the change was an improvement in the quality of science and an improvement in interdisciplinarity in environmental research in this country; and I think that at the end of the day we got greater value for money.

421. But what about the 50/50? You said that 50 per cent went to universities and 50 per cent to institutes. What was it before?
A. As to what it was before, in 1985, which was the first NERC corporate plan when Sir Hugh Fish was chairman, it was 18 per cent of the spend of the total NERC science budget in universities and it is now 35 per cent.

422. So competitive bidding in your case produced a shift towards the universities?
A. Competitive bidding and additional resources being put into universities.

[Lord Chorley *contd.*]

423. You said in your letter to the Chancellor that the flexibility offered by a variety of funding mechanisms was one of the ways of achieving your aims. I want to ask you, Professor Knill, to what extent does this mean that you support the dual support system?

A. Yes, my Lord Chairman, I do support the dual support system because I believe that it is providing a much more clear view of how money is being spent.

424. So unlike some of the other Research Councils you are not in favour of a further transfer of money to the Research Councils from the university funding?

A. I personally am not in favour, no, my Lord Chairman. I do not think that at the present time it would be very helpful. I was chairing a meeting this morning in relation to the response to an approach to the Chancellor regarding the dual funding transfer and its operation. I know that ABRC is considering that issue at the next meeting. At the present moment, however, I think that we certainly should have more time to go through before such a further transfer should be considered. I believe that universities must have a significant resource base of their own on which they can make their own decisions and determine their own priorities.

Lord Chorley] Thank you very much, that is very helpful.

Chairman

425. Professor Knill, thank you. I am sure that we have not exhausted you, but thank you for your energetic replies.

A. My Lord Chairman, thank you for a very enjoyable occasion.

Examination of witnesses

PROFESSOR T L BLUNDELL, FRS, Director General, and PROFESSOR J R KREBS, FRS, Chairman of the Animals Research Committee, Agricultural and Food Research Council, were called in and examined.

Chairman

426. Professor Blundell, Professor Krebs, thank you for coming. Are there any words that you would like to say by way of introduction?

(*Professor Blundell*) My Lord Chairman, I should be very happy to go straight forward into questions.

427. The first thing that I think we should like to know, Professor Blundell, is to what extent you regard assistance to wealth creation as an important part of your remit? To what extent does it affect your sense of priorities in the way that you spend your money?

(*Professor Blundell*) My Lord Chairman, I should like to review how we see our mission. Our mission is to provide knowledge to underpin activities of both industry and policy makers. Technology transfer involves both scientific opportunity and market pull from customers in industry and in policy departments. One very large and important component therefore of any future and certainly the present mission is basic and strategic science which provides the opportunities, but it needs to be close to that science which directly aids the competitiveness of industry. Although wealth creation has never yet been defined very adequately I believe that it is greater than just the competitiveness of industry; it also involves health of the workforce and maintenance of the environment. Thus our research priorities relate both to underpinning competitive industry as well as underpinning the policy for the various government departments. Our research underpins a broad area of industry involving not only food but also fibres, fuels, specialist chemicals and polymers. There is a broad area where we can contribute towards wealth creation.

428. I wonder whether you can describe with an example, if you wish, how you go about setting priorities that must take account on the one hand of the excellence or otherwise of the science proposed and on the other hand the possible usefulness of it?

(*Professor Blundell*) We always keep in mind the two aspects, my Lord Chairman, that is, the science opportunity and the market pulls from policy makers and industry. However, we have three levels of priority setting that bring in both components. First, there is what is now called technology foresight, which is illustrated in the think tank, in the scientific opportunities meeting, and in a number of open forums for discussion. Second, there is the level of strategic planning, which is carried on in our strategy board and our council, where we look at the more obvious and quite often continuing priorities; we reassess them against the criteria within our mission. Thirdly, there is the more detailed review of priorities that goes on in our research committees. For example, my Lord Chairman, Professor Krebs is chairman of one of our research committees and is involved in that. I could give you details of any one of those three areas.

429. Perhaps Professor Krebs would like to describe something from this area as to how he determines his priorities?

(*Professor Krebs*) My Lord Chairman, thank you. From the point of view of the research committees, of which the AFRC has four concerned with food, plants, animals and engineering, we have a well established procedure that all four committees work through on an annual cycle. We look at background information coming from government departments, from industry, from research scientists in the institutes and in HEIs and from overseas. We then take that background information as defining an envelope of possible research areas driven by the end users, both the scientists and the industry end users. We look in a subsequent meeting at our existing programme, we evaluate what is going on in the institutes and universities and finally, at the third meeting of the year, we put together the picture that we have built up over the year together with new ideas that have come forward either through, as

[Chairman *contd.*]

Professor Blundell mentioned, our scientific opportunities meeting or through the thank tank or through other sources feeding into the committee. In that way we develop a forward look which puts new ideas together with the existing programme and relates the whole cycle.

430. So that you have a sort of rolling programme?
(*Professor Krebs*) Yes, my Lord Chairman.

431. Can you give us some idea of the rate of change of that rolling programme?
(*Professor Blundell*) My Lord Chairman, I could give you an idea over a ten year period. Over the past decade our programme has changed from largely supporting animal and crop production towards underpinning the efficiency, the processing, the quality and the safety of food. That change has been due to market pull. Changes in scientific opportunity have also led to a major change of our staffing, reflecting the increase of molecular biology. Just to quantify that, my Lord Chairman we had 6,000 staff in our institutes in the mid 1980s; we have 3,500 roughly now. Out of those about 2,000 are permanent staff and about half of those are people working in molecular genetics and modern techniques which have become available over the last decade. Therefore, that science drive has been reflected in a very large change in the nature of our scientists employed. The other side of the bifurcation which is equally important is the systems side. I am a molecular biologist and John Krebs is a systems man. Probably neither of us 15 years ago would have seemed obvious candidates to come before you to represent the AFRC. Perhaps John Krebs could say how he sees the change in the system.

432. Indeed, I hope that he will. Half of what you had to say there was perhaps dictated from the outside, the reduction in the number of staff that you had.
(*Professor Blundell*) Yes.

433. I am sure that you did not do that voluntarily, did you?
(*Professor Blundell*) My Lord Chairman, I gave you those statistics so that you could see the changes that have occurred. No, of course, part of that reduction from 6,000 down to 3,500 was caused by a decrease of funding which came from a government decision that agricultural research was less important than it previously had been. The other part of it though came from a change of emphasis and a movement of our science investment from the institutes into what is quite often a slightly more flexible approach and increasing investment in the universities. Not all the reduction therefore is reduction of staff; on top of the reduction we had from the Government we have also changed our priorities and moved people between institutes and HEIs as well as within the institutes to new scientific areas of opportunity.

Lord Butterworth

434. Would your procedures for setting priorities be improved if the boundaries between research councils at certain instances were changed? You are saying that your setting of priorities was driven because of scientific changes. Would these be so great in the biological area that they might require a redrawing of the boundaries between one research council and another?
(*Professor Blundell*) My Lord Chairman, we do believe that there is an opportunity both for industrial applications and for science at the basic level from a biological and biotechnology oriented research council. It would certainly build on the opportunities and incorporate everything that the AFRC has developed over the past years. It would however reflect two changes! First, the importance of non-food products which come from biological processes in microorganisms, plants and animals. I think that that would then imply that we should want to look at the science expertise that we had within our research council and just from a purely objective level we are very strong on the whole animal and the whole plant side. Secondly the great complementarity of AFRC research with within biology and biotechnology that is within the Science and Engineering Research Council at present. I believe that under any structure SERC research has to feed into the science that we are doing in the AFRC. My own view is that it is best incorporated as a whole, into a single research council concerned with biotechnology and biology.

Chairman

435. There is a slight paradox, is there not? The techniques that you have described are ones that have fairly recently developed out of physics and chemistry? Are you saying that they have now become so freestanding that the links with physics and chemistry can be essentially put on one side?
(*Professor Blundell*) Coming also from the physical sciences I was once heard to make a similar statement myself, but I have found, in my time as chairman of the biology committee in the Science and Engineering Research Council and as Director-General of the Agricultural and Food Research Council, it is not the case that the new techniques have all derived from physics and chemistry. What we have seen is a real opportunity deriving from biological discoveries in the genetics and the physiology of organisms. These have come together with a better understanding at the molecular level aided by the physics which have allowed us to get over the problem of dimensions in going from the whole organism to looking at the individual molecule. I think therefore that this is an opportunity that is multidisciplinary. However, I think that the drive now is from the biological opportunity. We can also do things for physics and engineering, for example, understanding recognition processes in robots and, understanding molecular recognition by learning from biology. This is a two way process.

436. That is what worries me, Professor Blundell. You are saying that these sciences are still interlocked in all possible directions, a statement with which I personally would agree, yet you are now proposing to split biology up from the rest. We are supposed to be talking about priorities rather than structures. Let me ask you whether you think that your sense of priorities would be changed if biology was split off and put into a biology research council and the rest

[Chairman *contd.*]

became the physical research council or suchlike—would that make a difference?

(*Professor Blundell*) My Lord Chairman, both the size of a research council and the organisation of a research council are important factors. On the one hand there is the coherence of the science, which falls within its remit or its mission, and on the other there is the absolute size which allows efficient priority making and organisation of science in a sensible way. There are many arguments that would lead to the view that all science ought to be integrated in one research council. However, I have been a member of the SERC, and although I enjoyed it, I do not think that the answer is in very large organisations. My argument therefore for a biological research council start from the premise that we need workable and user friendly research councils. I believe that they come in roughly the same size as the Medical Research Council or the Natural Environment Research Council. I am not arguing against a total integration of all the research on the basis of clear boundaries between biology and other areas. It is a pragmatic approach. We must continue to emphasise the importance of creating across whatever boundaries there are very good and effective interactions between research councils.

Lord Dainton

437. Should those boundaries be changeable over time?

(*Professor Blundell*) If I think that they need to be changed now, my Lord Chairman, I should surely not argue that any boundary would be set in stone for ever. However, for the foreseeable future, for the next decade or so, I think that there are really very exciting opportunities which derive from biology although they will be multidisciplinary in their implementation.

Lord Chorley

438. Would not a thematic type research council therefore be a better vehicle than one that is discipline based?

(*Professor Blundell*) I do not see a biotechnology research council as a discipline based research council; I see it as an opportunity based research council. The opportunities came from the science drive, but are multidisciplinary in application. Any biological research council would need to include the engineering of our agricultural engineering and the engineering of biotechnology. It would need to have chemistry in an absolutely central role. This is under-emphasised at the present time but there should be a major chemistry component as well as the biological aspects.

439. But is there any real difference between a central body with six boards and six bodies with a central council?

(*Professor Blundell*) I am a great believer in devolution as far as one can get it. If you have six independent research councils in the sense that they are all non-departmental public bodies, each with a chief executive or director general, you do create the possibility of better management, and innovation in organisation in a way that is not possible in a huge, centrally organised structure. Just look at what has happened with research students. It has been the Medical Research Council and the Agricultural and Food Research Council who have recognised that new forms of studentship and increased stipends are required. It was the charities before that, of course. A plurality of organisations provides a catalyst for change.

Lord Dainton

440. My Lord Chairman, I wonder whether we might return to the business of priority making because this is what our problem is. To use your words obviously there is some that is scientific opportunity driven which gives quality and among that you would count as a quality of that excellence, I imagine, irrespective of the subject?

(*Professor Blundell*) I should—what else can there be in most basic science?

441. Yes, but then they would lean more towards other needs which are expressed by external bodies which come to your notice because you are thematic. How do you within your organisation balance off the one group against the other, given that the resources that Government will allow you are never enough for you to do everthing?

(*Professor Blundell*) Certainly we begin by reminding ourselves every day that there are scientific opportunities that will lead to applications that are not possible to see, and we have to protect a basic science process in which excellence is the measure. A large amount of science should be within that area. We then look to our priority setting quite often at a strategic level in terms of the obvious pulls from our policy and industrial colleagues. I am a firm believer that the best way is to define a broad area which leads to underpinning an activity but still allows the scientist to define the opportunity. I am very much against top down planning. But, of course, as we move through the spectrum we do get funding from our policy departments and from industry and there, of course, relevance will be defined on their criteria. Of course we try to make sure that the priorities for strategic science match where possible those priorities based on relevance.

(*Professor Krebs*) My Lord Chairman, it might be useful to think of two levels of dealing with priorities. At the strategic planning level one obviously takes into account, as Professor Blundell has said, both the end users and the scientific opportunities. When it comes down to the individual grants considered by the grants boards I think that there is a very strong emphasis on scientific excellence. The opportunity from the science is predominant at the grants board, while weighing up of the scientific opportunity against the policy and industrial needs occurs at the top end of the Agricultural and Food Research Council's strategic planning.

442. You do of course have commissioned work, do you not?

(*Professor Blundell*) We do, my Lord Chairman.

443. In order to be able to accept those contracts you have to have a certain competence in those areas. Has that been provided at your own expense and

[Lord Dainton *contd.*]

does that constitute a prior claim on your own monies and, if so, to what extent?

(*Professor Blundell*) My Lord Chairman, I think that we are a long way from optimising the forward planning between the policy departments and the research councils. I believe that we still hope to see strategic plans, and some commitment to the health of the science base from the Government departments. We do not see it to the degree that we should expect to see it. I am always impressed when I talk to my chairman, Sir Alistair Grant, by the way he emphasises the working together of the contractor and the customer in many of the supplier relationships in the retail industry. We have a lot to learn from working relationships in real industry as to how policy departments should move forward. We have encountered considerable difficulties through short term changes of priorities from policy departments and these are becoming more problematic now because they are driven by policy makers rather than by chief scientist groups. If we do not get a commission I am faced with retraining the scientists or making them redundant, and either of those usually costs about one year's salary. Much of that cost falls on the Office of Science and Technology. I believe that one thing that should come from the White Paper is a greater responsibility for the health of the science base from the government departments.

Chairman

444. You have talked about the effect that government departments have on priority setting. What about industry in your field?

(*Professor Blundell*) We spend a lot of time trying to understand where the important pulls are from industry, my Lord Chairman. About one third of our council are industrialists—retailers, food processors, agriculturalists and agrichemical companies—a wide range. Their views are reflected at all levels in our thinking. This year, as you will have seen in our corporate plan, and very much with the encouragement of our chairman, we have looked at the whole complex process of technology transfer and seen how it might interface with the beneficiaries at various levels. So we are very much conscious of technology transfer and we try to make it work at all levels. We work with small biotech companies that have come from the institutes, we have technology transfer people in every institute, and we have a central office industrial group. We are also beginning to look at proper rewards, for people who spend some of their time involved in technology transfer. We have continuous interaction at all levels with those working in industry.

Lord Tombs

445. My Lord Chairman, I want to go back to Professor Blundell's remarks about policy advice. I suppose that the Agricultural and Food Research Council is very close to the departments in policy matters as perhaps only the Medical Research Council is among the other councils. I want to ask whether a request for policy advice or policy support of itself constitutes an overriding priority for you or have you ever been forced or even inclined to decline to give such advice on the grounds of disruption of your basic effort?

(*Professor Blundell*) We have certainly had very great tensions caused by the requirements of policy. It is not quite as clearcut as the question implies because your Lordships may know that I have four members of the Ministry of Agriculture, Fisheries and Food on my council and I have one assessor in the Chief Vet. I also have agricultural assessors from the Scottish Office, the Welsh Office and the Northern Ireland Office.

446. You have a stacked deck of cards!

(*Professor Blundell*) It is a continuous process, my Lord Chairman. Perhaps I may give an example of the tensions that are caused. The bovine spongiform encephalopathies have been a very great problem and concern to the Ministry of Agriculture, and quite properly. This has affected United Kingdom exports of beef and it has affected our industry. Therefore, the Ministry of Agriculture has sought to invest very strongly in research into the spongiform encephalopathies over a very short time. That has led to reorientation of quite a lot of the endemic disease programmes which are less pressing perhaps for the next year but are probably more important in the long term. That has led to a decrease in their funding. Of course, spongiform encephalopalties are a fascinating scientific problem because we do not know the nature of the agent, we do not know the process; it may be a Nobel prize problem! Nevertheless, it has caused considerable distortion. We have reluctantly moved out of some areas of endemic disease research. But, of course, quite a lot of it is just reflecting the removal of commissions and the reinvestment in commissions in a different area, even in a different institute.

447. Are there examples where you have declined to give such advice on the grounds of disruption let us say of a less high profile form? If not, I should be tempted to suggest that the request for policy advice from departments to a large extent sets your priorities?

(*Professor Blundell*) My Lord Chairman, I do not think that that is the case. It is a question of balancing the priorities from the industrialists, who are increasingly vocal and more confident of their point of view on my council, much more so, I think, than in Lord Selborne's days as chairman. They certainly would do very well in competing with policy makers. We also have some very articulate and thoughtful scientists like Professor Krebs on our council. I think we make a very balanced decision in the end from the pressures that quite properly come from all those directions.

448. May I ask whether all these useful pressures have in fact resulted in your rejecting requests ever?

(*Professor Blundell*) Well of course it means that we do not move—

449. As fast as you might?

(*Professor Blundell*)—in the direction as far as the policy holders would like us to. There is no doubt about that. I understand that the ministry thinks that next year we should remove about a quarter of our funding from our engineering institute. I am objecting to that, but I have to remember that most

[Lord Tombs *contd.*]

of that funding comes from the ministry and if they remove the funding I have to pick up the bits and put them together in a new scientific and engineering programme.

450. That is not quite the same point.

(*Professor Blundell*) But, of course, I am resisting very strongly. Perhaps Professor Krebs would like to comment as a participant in the council.

(*Professor Krebs*) My Lord Chairman, the only point that I should add in amplifying the last point that Professor Blundell made is this. It does as a matter of fact happen to be the case that for some of the Agricultural and Food Research Council institutes a substantial proportion of the budget comes from government departments. In these cases one has difficulty in declining invitations to undertake certain kinds of research, because of the consequences for funding.

Earl of Selborne

451. My Lord Chairman, if I may just pursue that point, is not the real problem—and Lord Tombs I think has put his finger on it—that it is not the same answer. Are not the Ministry of Agriculture acting not as a customer seeking policy advice but still acting, in the language of Rothschild, as the vicarious customer? I cannot believe that the work that you are doing in agricultural engineering funded by commissions from the Ministry of Agriculture is all needed for policy advice.

(*Professor Blundell*) My Lord Chairman, we certainly believe that the percentage of the engineering component of the Agricultural and Food Research Council should be increased from OST funding. But there are restricted amounts of funds available. I agree, however, that we need more of a science based contribution. My own preferred model would be to have the Medical Research Council model where the Rothschild funds are transferred back to the research council and a concordat is established so that we can reflect the health of the science base in the priorities that we set. You cannot separate the health of the science base from priority setting. It is no good saying that this year we want this expertise and expect to close down another area and to pick it up in five years time; it is not there. I think that that is the problem that we need to share with all our customers who expect to use our services in the future.

Chairman

452. There is the opposite point of view that other research councils might hold that the best thing that you can do is to find the brightest people in your area and make sure that you support them properly almost irrespective of what they want to do?

(*Professor Blundell*) I believe that any research council must have that as a very large component, but not as the total of their activity. Let me give you an example in the bovine spongiform encephalopathies. We have within that area expertise on the genetics of strains of animals that are susceptible to these diseases; we have quite a lot of work on the molecular basis of some of the agents involved. We also need to introduce some neurobiology into the programme. Academics quite often have not responded quickly enough and we have to look specifically for neurobiology expertise within that strategically defined area. I do not think we could just go away and say, well, neurobiologists will turn up to work in that area. The fact is that they will mostly gravitate towards the medical side.

Lord Dainton

453. Are you not really saying that the difficult problem that you face and that all research councils face is somehow serving the needs of the present without sacrificing your capacity to meet problems in the future?

(*Professor Blundell*) The old probem of sustainability of our expertise.

454. So this is a factor of balance that has to come into all your priority setting?

(*Professor Blundell*) Yes, my Lord Chairman, I think so. From my experience of heading a research council it is quite unrealistic to think that one can take any one simple factor in setting priorities. One has to accept that there are going to be pressures from all kinds of beneficiaries and all kinds of scientific opportunities. Like any other activity in life it is a question of optimising the different pressures. To make a statement, however, that all you need to do is to pick the best scientists just does not satisfy the various complex pressures upon us, but it has to be an important component.

Earl of Selborne

455. My Lord Chairman, I want to go back to a different field, if I may, that is, structures within the Agricultural and Food Research Council, and Professor Blundell has reminded us that the number of sites has reduced as well as the number of scientists and this has led to greater flexibility and, presumably, greater ability to set priorities which are not determined by the logistics of having a research centre in whatever. You have moved your horticultural research into a combined institute with the Ministry of Agriculture. That has the effect presumably of giving you still greater flexibility in the sense that you are no longer directly responsible for those institutes. Is there a lesson to be learnt form this? Could you shed all your institutes and thereby achieve the greatest possible flexibility?

(*Professor Blundell*) Let me say first, my Lord Chairman, that I do not think that you create flexibility by cutting out things and removing the funding for them, which is largely what has happened in parts of the Agricultural and Food Research Council over the past ten years, and that has been clear over the past three years when we have had to restructure and find new buildings. If we have reduced responsbility we do not get further flexibility necessarily. I believe in a mixed economy of structures within the research council. There is much that the institutes can do in contributing to priority setting and to carrying out the research that the universities cannot do. These are very complementary activities.

(*Professor Krebs*) My Lord Chairman, perhaps I may add that by having the institutes and the higher

[Earl of Selborne *contd.*]

education institute sector under the same umbrella one is able to put together integrated programmes such as, as the noble Earl, Lord Selborne, will know, a number of co-ordinated programmes that the Agricultural and Food Research Council has mounted over the last five years split more or less equally across the institute/HEI sector. To plan in that way for a major programme is much easier if all the organisations belong under the same umbrella, I should argue.

Chairman

456. I should be interested to know whether the ABRC has encouraged you to change your policies, your priorities, whether it has perhaps more or less forbidden you from doing something or demanded that you do it. Can you say a few words about how you interact with the ABRC?

(*Professor Blundell*) My Lord Chairman, I believe that the ABRC plays a most important role that has been undervalued both by government and by the scientific community. It has been unfortunate that for a period of time its advice was not published; and we are all pleased that it was published last year. It is important that there is an open discussion about priorities. The ABRC allows, within the whole of the science base, the movement of funds between different priorities as the scientific opportunities and the market pulls change. Therefore, my Lord Chairman, I think that it has played a very important role. It has created the opportunity quite often to move into new areas. But its main role must be to advise on the balance between new opportunities and to act as a catalyst for the interactions between the different research councils. This is a very important role.

457. And you think that it has been effective?

(*Professor Blundell*) My Lord Chairman, I think that it has been extremely effective but very much undervalued.

Lord Porter of Luddenham

458. My Lord Chairman, I have just one quick question which arises out of paragraph 8 of the submission to the Chancellor. First of all—if this is not to put words in your mouth—would you not agree that the selection of priorities is such a difficult hit and miss problem that one does need a plurality of sources?

(*Professor Blundell*) Yes, my Lord.

459. No single body is quite right?

(*Professor Blundell*) I have certainly always argued for plurality of sources.

460. Thank you. Then on paragraph 8.3 I should like to ask just what you do mean because you say, "The dual support transfer has helped movement towards a fuller costing of HEI research". All right, it has helped the finance, but if one goes in this direction—and you talk about a "radical approach ... to transfer the entire funding to the research councils"—you then go on to say, "What is needed is a procedure to identify with greater precision than at present how research funding in universities relates to research council support of research". Is that not really saying that they have got to get together and relate their choices? They do not have the independence of making individual separate choices regardless of each other?

(*Professor Blundell*) My Lord, I think that that is true, but under the dual support system, although we have had some clearly identified marginal funding from the research councils, we have less clearly identified funding for research through the universities. We have not identified the fact that in the universities there is not enough money to underpin the research that is funded by the research councils and also that extra seedcorn or blue skies, innovative work that should be funded by the universities. My justification for identifying full economic costs is to make it clear that we do need extra funds within the universities. It is very confusing if we have a situation where it is expected that a certain sum of money is there both to support research council funding but also to fund seedcorn research. I believe that a clear definition of the amount of money that there is for seedcorn research would be in the best interests of the universities in the long term. There has been a great deal of confusion on that issue.

461. I must say, Professor Blundell, that I am still confused by your answer! You say that there is not enough money for the universities but then you support taking it away and giving it to the research councils.

(*Professor Blundell*) Ah, because the only money that the research councils want to identify with the research council grants is the full cost of the science that they are funding. Now I know that if I am running an organisation of institutes it costs roughly three times the direct salary to run each of my research scientists. I know that if those scientists are going to be properly working within the institute they need proper facilities, proper support and all the other aspects of the well found laboratory that make the research possible. We want to be sure that that type of support is there in the universities and that in addition there is seedcorn money.

Chairman

462. Is it not a fact, Professor Blundell, that much of the money taken from the University Grants Committee budget because it was the part required for the support of existing research council grants has in effect been awarded by research councils to fund further grants?

(*Professor Blundell*) It has not been the case in our research council, my Lord Chairman, and it would be quite wrong if it were the case. There have been some problems, I understand, from the BUFOG—the British Universities Finance Officers Group—in the formula relating the grants to the extra costs. I believe that that can be overcome. In my own research council we have very carefully looked at that and we are confident that the monies that have been awarded are what would be expected for the proper support of the grant. We have not awarded more grants than we should have done otherwise.

Chairman] Professor Blundell, Professor Krebs, perhaps we may leave it there. Thank you very much for coming and for the time and effort that you have put into it. We are most grateful.

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THE SELECT COMMITTEE ON SCIENCE AND TECHNOLOGY

(SUB-COMMITTEE I—PRIORITIES FOR THE SCIENCE BASE)

PREVIOUSLY UNPUBLISHED EVIDENCE

WEDNESDAY 19 MAY 1993

Present:

Butterworth, L.	Porter of Luddenham, L.
Dean of Beswick, L.	Selborne, E.
Flowers, L. (Chairman)	Tombs, L.
Perry of Southwark, B.	Carnegy of Lour, B.
	White, B.

Memorandum from the Higher Education Funding Council for Scotland

1. What is public expenditure on the Science Base for?

Support for the science base recognises the social, economic and cultural benefits that flow from research and development: in this context SHEFC particularly notes the emphasis on wealth creation in the recent White Paper "Realising our Potential: A Stategy for Science, Engineering and Technology".

Plurality of funding sources under the dual support system allows support both for a basic research infrastructure and for specific projects. In particular, the more stable and reliable funding from the HEFC arm of the dual support system is necessary to maintain the quality of academic expertise and to enable staff to remain at the forefront of their discipline.

2. What are the objectives and priorities of the various funding agencies within Government?—Research Councils, HEFCs, other departments. Are they related? Is an overview required, and do the existing structures (ABRC, ACOST, OST) provide it?

The broad objectives and priorities of SHEFC are laid out in the Council's Mission Statement and are to promote the quality and encourage the expansion of teaching and research in Scottish Higher Education Institutions through the efficient use of public funds.

SHEFC is not particularly well placed to comment on the objectives of the research councils and other Government departments. It notes, however, the arrangements set out in "Realising our Potential" for ensuring co-ordination between the various funding agencies. SHEFC will further develop its existing relationships with these bodies under these new arrangements.

3. What are the relationships connecting Government funding of the Science Base, funding by industry and charities, and overseas funding (particularly from the EC)? Various people are "paying the piper": are they calling different or incompatible tunes, and if so, is this a bad thing?

Government funding of science, through the dual support mechanism, provides for the costs of the basic infrastructure of university research. This allows the maintenance of a research capability through which others can fund specific projects. SHEFC sees very positive advantages in the dual support arrangements, particularly in enabling institutions to undertake speculative research which might not immediately win funding from research councils or other sources.

4. What information and advice is needed by those who are setting priorities? How do they know what is going on in low priority fields? How do they track developments overseas?

The Research Assessment Exercise already provides a comprehensive record of research quality in the United Kingdom, covering the whole range of academic disciplines.

The technology foresight exercise announced in "Realising our Potential" will also be important in this context and will have an international perspective.

5. How do charities and companies which fund research set and implement priorities? How is it done overseas? Are there lessons here for the Government?

SHEFC believes that others are better placed to comment on this aspect.

6. What are the objectives and priorities of the HEFCs in funding university research through block grants, and who is setting them and on what basis?

The objectives and priorities of SHEFC in relation to research are laid down in its Mission Statement and are to:

- secure greatest value for money by increasing selectivity
- encourage institutions to widen their funding base
- support mainly basic and strategic research
- support new developments in research activity and take account of the needs of the economy and changing patterns of demand

— increase accountability for the use of research funds

These objectives emanate from the White Paper "Higher Education: A New Framework". SHEFC will, however, review its work in this area in the light of the more recent White Paper "Realising our Potential".

SHEFC research funds are distributed by means of two formulas. 95 per cent of resources are distributed with reference to quality and volume measures at the level of the 72 units of allocation and 5 per cent of resources are allocated by institution. This allows some institutional discretion to enhance areas of research potential.

The SHEFC research funding method, like the HEFCE method, is based on an allocation of resources to subject areas according to previous patterns. Although there may be possibility of a historical imprint as a result of this method, historical patterns of allocation were the only practical starting point and were modified to eliminate unjustifiable anomalies. In this way, the existing funding formula has minimised moves in the balance of funding between disciplines. If the Council were to review its priorities and objectives in research funding, it would be possible for the Council to increase funds to particular units of allocation, but this would be at the expense of other units unless extra resources are forthcoming from the Government.

7. How is each university's block grant distributed between departments, and on what basis?

SHEFC allocates research funds by reference to departments. Institutions then have discretion in their expenditure but SHEFC has indicated that it would wish to be consulted where they diverge markedly from SHEFC's pattern of allocation.

8. What are the impacts on priority-setting of: abolition of the binary divide

SHEFC's research funding method is designed to fund good research irrespective of the institution's past history. It allows all institutions access to research funds provided they meet the required criteria, although in general SHEFC would not expect institutions markedly to change their missions.

However, removal of the binary divide may, in fact, allow more accurate and wide ranging prioritisation as research is considered in the form of a unitary rather than binary sector.

In terms of the balance of research between disciplines, although institutions formerly funded by the SOED tended to concentrate on science and technology together with directly vocational courses, it is hard to make direct comparisons of volumes of research. Insofar as this is possible, we doubt whether any sizeable move has taken place; since it should be noted that the volume of research undertaken by the former SOED institutions is smaller than that which would be expected of UFC institutions with comparable staff and student numbers. In support of this, the former UFC institutions received more research funds for 1993–94 than 1992–93, even allowing for inflation.

The Regionalisation of Funding

SHEFC, in carrying out its responsibilities for research funding, will do so with the particular circumstances of Scottish institutions and any wider implications for Scotland as a whole, very much in mind; this will, however, be in the context of wider Government policy and the new arrangements set out in "Realising our Potential".

The Shift of Emphasis from Core Funding to Project Funding involved in the Transfer of £150m p.a. from the HEFCs to the Research Councils

The decision to transfer some of dual support was made before SHEFC became operational and so Council has not thought it necessary to form a view on its impact. However, SHEFC has noted the Government's reasons for the transfer in terms of information and accountability. The Council welcomes efforts by the Research Councils and institutions to monitor these changes. It is really too early to comment on the effects but SHEFC welcomes Government assurances that the financial effect of the transfer on institutions should be neutral.

Formula-Funding, Research Rating and moves towards an R-T-X Model?

Formula funding has the advantage of allowing objectivity and transparency in allocation of funds, while retaining a foundation in peer review through the use of the ratings from the research assessment exercise. An R-T-X model has not been discussed by SHEFC, since its research funding is selective by departments and not by institution.

RESEARCH COUNCILS

9. The Research Councils have explicit missions. How are these translated into priorities, by whom and on what basis?

10. How are the competing priorities of the different Research Councils (and the Royal Society and the Royal Academy of Engineering) reconciled within the limits of the Science Budget?

11. Are the priorities of the Research Councils skewed by the boundaries between the Councils' remits, by the existence of Research Council institutes, by international obligations to support "big science", or by anything else?

12. How is the money transferred from the UFC to the Research Councils being spent?

SHEFC believes that others are better placed to comment on these aspects.

Examination of witnesses

PROFESSOR JOHN ANDREWS, Chief Executive, DR ROWLAND WYNNE, Head, HE Funding Council Division, and SIR JOHN CADOGAN, Chairman, Research Group, Higher Education Funding Council for Wales; and PROFESSOR JOHN SIZER, Chief Executive, MR DAVID WANN, Director of Funding, and MR PETER WILLMAN, Principal Officer, Funding Directorate, Scottish Higher Education Funding Council, were called in and examined.

Chairman

463. Professor Andrews, Professor Sizer, thank you very much for joining us. I hope that you will agree to behaving like one team of people.

(*Professor Andrews*) Certainly, my Lord Chairman.

464. Thank you very much. May I then put put first this question: do you think that the money that was formerly the UFC's and the PCFC's has been distributed between the three funding councils—England, Wales and Scotland—in a reasonably comprehensible manner?

(*Professor Andrews*) First of all, my Lord Chairman, the PCFC money was an English only fund anyway and it had no application in Scotland and Wales. The UFC money was distributed on the basis of the money that was going to the existing institutions in England, Scotland and Wales by arrangement between the civil service departments, not by arrangement with the funding councils, but I do not think that any of the funding councils would quarrel with the distribution.

(*Professor Sizer*) My Lord Chairman, I think that our position is the same. I am not in a position to say what the transfer was because it was settled before we were established, but we estimate that we had a modest increase in resources available to us from the Secretary of State's block grant in Scotland. Given the public expenditure context in which that allocation was made we are content with it.

465. We have heard from the English Funding Council how they go about their business and much is inherited from your forebears in any case. Therefore, rather than ask you both to recite what happens I wonder whether you can tell us whether there are significant differences between what you do in Wales and Scotland and what they do in England?

(*Professor Sizer*) My Lord Chairman, I think that there are some differences between the Scottish model and the English model. Perhaps I may ask you in what degree of detail you would like those differences elaborated?

466. We should like you to tell us anything that you think is significant.

(*Professor Sizer*) We start off from the position that we want to develop the best funding model for Scotland rather than simply adapt the English model to a Scottish situation, and we went through a period of extensive consultation in order to do that. On the other hand, all of the models were required to distribute the funds selectively in terms of the research assessment exercise. Ninety five per cent were distributed on the basis of the research assessment exercise, but while the broad structures are similar there are sub-components of the way that we distributed the 95 per cent selectively which are different from the English model. Effectively, we then distributed the remaining 5 per cent of our research funds on the basis of an income model, essentially using income as a proxy for quality in departments rated below 3. We were using the argument essentially that if someone is willing to purchase research in those departments they take some view, at least, in taking the decision to purchase that research that there is research of quality likely to be undertaken. Those therefore are the two components of our model while the English model, as you are probably aware, had three components, the QR component, which was equivalent to our 95 per cent, a CR element for contract research income and the DevR element. Our model does not have that separate contract formula element, but in the volume drivers in the 95 per cent we take account of all forms of research income and, as I say, our equivalent to DevR is driven by research income in the department rather than simply by the fact that the department has a rating of 2 or more. Those therefore are the broad outlines, my Lord Chairman. As to the other key things, I will just pick up one or two of these. In the case of the volume measures the main difference is the way that we have treated external income. We have used all external research income rather than just the charitable income as in the English model. The second point is volume weightings where we use a slightly different weighting from the English weighting for research income and research students. The third key difference, which I think arises also in Wales, is that we did not use the J minus 1 model for the transformation of the research assessment ratings into the model; we used a 40 per cent step model so that it is a 40 per cent compound growth in the weighting. A 2 rated department therefore was rated as 1, a 3 rated department, 1.4 and a 4 rated department, 1.96 and so on. We therefore had even steps between the various points beyond the 1 rating, for which of course we provided no funding.

467. I think that that is probably minor stuff as far as we are concerned.

(*Professor Sizer*) Then I think the final difference is that we did not differentiate in our funding method between the applied ratings in the research assessment exercise and the basic strategic ratings partly because, as you know, there were some problems with the exercise, but also there were in fact only four submissions from the whole of Scotland on

[Chairman *contd.*]

the applied side. Therefore, we decided to merge the basic and strategic and applied ratings in our model. Those are the major differences, my Lord Chairman.

468. Thank you. Now Wales?

(*Professor Andrews*) My Lord Chairman, we circulated the English consultation paper to our own institutions and invited their responses. The thrust of what they said was that they would prefer a methodology that was similar to the English methodology, but there were occasions when they thought the particular needs of Wales might better be expressed. We distributed effectively under four heads. Eighty nine per cent of our funding was distributed on the basis of quality weighting. The methodology was very similar to England's. The two main differences were, first, that in each unit of assessment we used base levels that were drawn from UFC funding whereas in England, of course, they had to feed in PCFC money and take out what was earned back by PCFC institutions. We did not have that problem. The research base in the public sector institutions in Wales is very limited so we went back to UFC base figures. Secondly, we slightly raised the funding of 3 rated departments in Wales. The reason for doing that is that we are seeking to improve the research base in Wales and that means getting more departments up into the 4s and the 5s. We want to give a slight head start to our 3s as part of an overall strategy. Contract income we distributed very much as in England. The other two areas, my Lord Chairman, are a small amount of DevR funding for the former public sector institutions, that is, 2 per cent of our funding, and more significantly, I think, 6 per cent of our funding, £2.25 million, which has been specifically earmarked for raising the quality of research in Wales, and that has been distributed on a proposals basis by a group that is chaired by Sir John Cadogan.

469. You are part of the dual funding system; the other part is the research councils, and the research councils have national priorities, that is to say, United Kingdom priorities, whereas to some extent at least you are trying to follow Welsh and Scottish priorities. Does this present you with any kind of problem?

(*Professor Andrews*) The first point that my council would say is that they wish to improve the quality of research in Wales—Wales has not scored as well in the research assessment exercise as we should wish—and we wish to seek improvement against the standards of research in the United Kingdom as a whole. It means funding our institutions comparably with the funding that they would get if they were in England or Wales or Scotland or wherever. In large measure it means giving them the freedom to research in the best way that they are capable of without restriction. Inevitably institutions in their research will tend to reflect some of the environmental circumstances that determine their make up. You would expect in Wales that a fair amount of research is devoted to Celtic studies, for example, and science research in Wales in the rural colleges particularly takes on an environmental strength; engineering is stronger in south Wales. But here what you are seeing is the institutions themselves in large measure reflecting their regional environment. The council itself has been asked by the Secretary of State in his letter of guidance to have regard to his economic policies. We are pursuing that in two ways, my Lord Chairman. We are pursing it in part with some of the money which is being distributed on a discretionary basis—this is back to Sir John's research group—and we are pursuing it closely also by working with bodies like the Welsh Development Agency, the Welsh Office and other public services in Wales to see how we can interface institutions with industry and with the public services. As far as being more specific is concerned and seeking specific regional interest and perhaps interfacing the institutions more closely with industry we do tend to come up against a barrier, and that is the distinction which is drawn for our funding purposes between basic and strategic research on the one side and applied and near market research on the other; this is very much a barrier as you try to bring higher education institutions more closely to industry. We can push them, my Lord Chairman, but we cannot really pull them because we cannot use any funding of our own to pull them forward in that way.

470. The English Funding Council more or less admitted when we questioned them that they were not by themselves important drivers of research policy any more because they were, so to speak (these are my words rather than theirs) holding a mirror up to what research councils and charitable organisations and government departments and so on had by way of priorities rather than anything they had of their own. Now from what you are saying there is a Welsh dimension you are trying to insert or superimpose over anything that the English council might be doing. Does that go for Scotland too?

(*Professor Sizer*) Not to the same extent, no, my Lord Chairman. As my colleague said, in Wales the Secretary of State provides specific guidance as to how he would like to see research strengthened. We did not have that same guidance, nor a specific sum of money for that purpose. Clearly we are required to take account of the needs of Scotland, but at the same time there is a very strong desire in Scotland to be seen to be part of the United Kingdom wide research system. Given that our purpose is to fund the infrastructure and not to fund particular programmes of research, an infrastructure which the institutions will build on in their relationships with the research councils, or with other funders, I think that it is too early for us to say whether there are any conflicts between regional and national issues. Inevitably therefore there are bound to be some winners and some losers in the sense that the funding methodologies assume that the DR transfer will be returned to the institutions in the way that it went out, but it is clear that if the research councils change their priorities that is going to change their decision making and that could change the way that money is distributed. However, as long as the research councils continue to take a United Kingdom perspective then I do not sense any major problems in Scotland. The research councils have a large number of research institutes in Scotland and I have been working hard to establish contacts with all the research councils and with the ABRC and we have on our council a member of the Science and Engineering

[Chairman *contd.*]

Research Council, a member of the Natural Environment Research Council and an assessor for the Medical Research Council, so that we are developing good relationships. We intend to try to maintain those, but I think that it is too early to say whether in fact there are problems of the sort that you naturally envisage, my Lord Chairman.

Baroness Perry of Southwark

471. My Lord Chairman, I should like to address a question perhaps specifically to Professor Sizer about the decisions that you made for your methodology. On the whole in Scotland particularly you went very much for rewarding excellence, weighting the methodology of your measures towards the better departments and skipping the DevR element. You must be aware that what happens within the universities will not necessarily reflect the way in which the methodology was built up. The individual vice chancellors may decide to do something different with the money from the way that you constructed it. Do you intend to monitor that? Do you intend to ask them to account for how they distributed the research money when it reached the university? As a supplementary to that, my Lord Chairman, if I may, what would you regard as a matter of concern and would you wish to readjust if you found that the money had been spent in a very different way from the way in which you had first calculated?

(*Professor Sizer*) My Lord Chairman, I think that first of all I should perhaps correct the impression that we were more selective than England. I think that the 40 per cent step model that we used is slightly less selective than the J minus 1 model.

472. It depends where you are on the scale.

(*Professor Sizer*) I agree. Ours is a more even scale because we did not put any caps into our research model, although we did provide a safety net for overall resources—for teaching and research—at the end. That having been said, I have had a long interest in research accountability going back to my UGC days so it was interesting to come to this issue again in Scotland. We envisaged four stages in this process of accountability to ensure that the funds are being used for the purposes intended. First of all, we have said to the institutions that we recognise that no funding model can mirror the precise requirements of any one institution and it is clear that managerial judgment has to be exercised as far as how the broad allocation is used internally and therefore we should expect institutions broadly to distribute the funds the way that they came to the institution, that is, broadly distribute them selectively with reference to the research assessment exercise. As you probably know, my Lord Chairman, in Scotland we have divulged all the detailed calculations of our model not just to one institution but to all of the institutions so it is a very open process. That then is the first thing. We have said, of course, that if institutions intend significantly to deviate from that broad allocation then we should expect them to come to us and to inform us of that. One key part of that is in our request for corporate plans where we have asked institutions to indicate in those plans how they intend to use their research funds and where they wish to use them in a significantly different way from how they were generated by the model.

473. Apart from the corporate plan do you intend any financial monitoring of what happens?

(*Professor Sizer*) Those are the first two stages. In the third stage within the corporate plan we will be asking questions about the way in which research resources are managed. In the first stage, of course, we are at the moment consulting our institutions as are the other two funding councils on how research spend should be accounted for. In the Scottish consultation paper we have made it clear that we regard understanding the way that the university manages its research resources as a key part of accountability rather than simply looking at what happened after the event when the horse may have already bolted. We are, of course, consulting about the Coopers' report, which proposes a number of models for subsequently identifying how the resources were used in relation to the allocation. There is, if you know the options set out in the Coopers' report, a further option, which is to go for a detailed post event accounting model and ask the institutions to tell us how they have spent their resources as opposed to the allocation. Our council has taken the position that we think that simply telling us how the resources were allocated is sufficient and the reason, I think, is that, perhaps because we have got one or two accountants on the council, we are not convinced that the incremental costs of developing a full absorption costing model for after the event accounting is going to be outweighed by the extra benefits. The final stage, of course, my Lord Chairman, is the next research assessment exercise. Therefore, I think that there is a logical sequence in all this which I believe all our institutions understand and we clearly see accountability as being concerned not just with how the money was spent but with whether it was used for the purposes for which it was intended.

Chairman

474. I had hoped that when you split off from England you would shed a lot of the overwhelming bureaucracy that was practised by the former funding councils. It sounds to me as though, at least in Scotland, we have not done so?

(*Professor Sizer*) It depends how broadly we intend to do this. We are required by the Secretary of State in his letter of guidance to ensure there are satisfactory mechanisms in place.

475. Do the Scottish universities get more or less paperwork as a result of the setting up of a Scottish Funding Council?

(*Professor Sizer*) I think that they will in fact get less paperwork because the corporate planning framework that we have developed does not require long descriptive plans as was the case with the UGC but rather asks for more specific descriptions of research management processes.

Baroness Perry of Southwark

476. It does seem that you are going much further than the English council in determining priorities at your level, that is to say, the funding council level,

[Baroness Perry of Southwark *contd.*]

and restricting the freedom of managers within the institutions themselves to determine priorities. Would you accept that? Perhaps we might hear from Wales, my Lord Chairman, whether they believe that to be the case.

(*Professor Sizer*) My Lord Chairman, I cannot comment in detail on what the English Funding Council is going to do. I stress again, however, that we have said and we have intimated that we should expect the institutions to use the funds broadly in the way that was intended, and I think that we have made it very clear that the emphasis is on broadly. But it is clear that if an institution wishes significantly to deviate, for example, if an institution which had a high proportion of 5 rated science departments decided to allocate the whole of that incremental funding to build up weak 1 rated arts departments, then I think that the council should be asked to approve that strategy. On the other hand if an institution with a large and 5 rated department wished to allocate the funding within the broad science and technology area in a different way from which the funds were generated because that was clearly the view of the university as to how best to build upon the existing strengths and to complement and to reinforce them, then I do not think that there would be any problem at all. I do not think therefore that we intend to have a detailed bureaucracy. What we do have to do, however, my Lord Chairman, is to satisfy ourselves that broadly the funds will be used in the way that was intended. That is in line with the White Paper that preceded the establishment of the council and the letter of guidance that I have had from the Secretary of State.

Chairman

477. I wonder whether Wales would like to deal with Lady Perry's question?

(*Professor Andrews*) My Lord Chairman, I think that one point one has to recognise is that there is an increasing demand from Government for selectivity in the way in which research money is distributed, and if we simply worked out on a building block system a global sum that we gave to institutions to distribute as they wished, they could undo the whole selectivity exercise by distributing it equally across all units within the institutions. We have made clear to institutions how much money has been earned in each unit of assessment. We shall not be restricting the institutions to distributing the money in precisely that figure to each unit of assessment although we should expect them to do something similar to that, not least because that would probably be in their own best interests if they wanted to score at least as well in the next exercise. It would also ensure a quieter life, I think, for principals and senates if units of assessment got something approximating to what they had earned. On the other hand, my Lord Chairman, it would be quite wrong if we did this to the exclusion of any local discretion. It is clear that there are advantages for institutions to have a discretion when they wish to build up new units or where they see promise or potential, and if they wish to top slice some money for a worthwhile purpose then I think that we should encourage that.

Lord Porter of Luddenham

478. One of the broadest priority choices that one has to make is between applied and basic research, and both of you have referred to that. I ask the question in the context of the Prime Minister's speech last night where he declared that he wanted to see a big shift of funding towards wealth creating research, and so on. Professor Andrews said that there is a barrier—and I did not quite understand who has created this barrier—between basic and applied research which you find it hard to overcome. Professor Sizer said you had only four—I think this is what you said—centres of applied research, is that right?

(*Professor Sizer*) Within the research assessment exercise there are only four universities that in fact made submissions that related to applied research. I should say, my Lord Chairman, that I think that it is generally felt that the methodology was flawed, and that is one of the reasons for it.

479. What are the feelings of the two councils about whether the present balance between pure and applied is right and, if it is not, where should it go and what will you do if the Prime Minister's wish is implemented and we are all told that there must be a big shift to wealth creation?

(*Professor Sizer*) The letter of guidance that we had—and I am sure that it is the same for my colleagues in Wales—from the Secretary of State when the council was established precluded us from supporting near market research, and we welcome the debate that has taken place since round the Office of Science and Technology White Paper and the statements that were made last night by the Prime Minister.

480. I am sorry, what was the statement about near market research?

(*Professor Sizer*) I will just find the precise quote, if I can, my Lord Chairman. Broadly I think that we welcome the shift. There is a strong feeling in the council and in institutions in Scotland that there is a strong case for supporting applied research. Therefore, we await the outcome of the OST White Paper and it is clear that we are going to have to review our funding methodology when the White Paper comes out. My Lord Chairman, I now have the letter in front of me from the Secretary of State and under the heading, "Type of Research to be Supported", it says: "The Higher Education White Paper made clear that public funding is intended mainly to support basic and strategic research which is not expected to lead to commercial applications in the short term." That is the framework within which we are operating, and we have to use 95 per cent of our funds for that purpose. If the guidance changes and there is clear indication that we should give more support to applied research then we are going to have to change the paramaters in the model. I suspect, though, that there is some misunderstanding around about what the Prime Minister has in mind and possibly what is intended in the White Paper. When you go and talk to people in institutions they sometimes seem to think that applied research is doing some testing for some small company round the corner rather than research which I assume is

[Lord Porter of Luddenham *contd.*]

primarily concerned with creating and sustaining international competitive advantage in the sort of businesses with which Lord Tombs is familiar. Therefore, I think that we are going to be interested to see what comes out of the White Paper, but broadly we welcome this fresh look at applied research, particularly the industrialists on our council.

481. But you are listening to the master all the time here, you have to do as you are told in that respect; you cannot inject your own views as to what is best for Scotland?

(*Professor Sizer*) We have to operate within the letter of guidance from the Secretary of State, my Lord Chairman, yes.

Chairman

482. Is there a Welsh answer to Lord Porter's question?

(*Professor Andrews*) My Lord Chairman, when I talked about the barrier it was precisely that, that our letter of guidance from the Secretary of Stae enjoins us to fund basic and strategic research. We are told at one point that we can take into account performance in applied research, but only in respect of funding basic and strategic research; in other words, where an institution had a rating for applied research we could take it into account, and we do, in fact: we have accepted applied research ratings multiplying them by 0.25 to arrive at an applied research funding formula on which we can fund basic and strategic research. The funding is for basic and strategic research and not for applied research. This does not fit as well as we should like with the other instruction from the Secretary of State, which is to have regard to the economic needs of Wales in our funding of research. For example, one of the things that I should like the council to be able at least to consider is the possibility of using some of this funding to support applied research on the basis of at least matching funding from industry. I think that, this might well encourage a number of science departments to take more interest in applied research and to work with industry. There are at the moment a number of departments in Wales that are working with industry, but it is a relatively small number, and I think that if the funding council was able to provide a lead, this would encourage a lot more departments to look to the interfaces with industry.

483. Are there also indications from industry that they might play that game?

(*Professor Andrews*) In Wales we have the advantage of the Welsh Development Agency, which has succeeded in interfacing a number of science and engineering departments in Wales with Welsh industry. We should like to involve ourselves in this because I think that if we from the other side can encourage the institutions, or departments rather than institutions, to move towards industry and the Welsh Development Agency can do it from their side, we are not going to change the culture overnight, but we do have a chance to move in that direction.

(*Sir John Cadogan*) My Lord Chairman, you must remember, of course, that in Wales most industry is in small to medium enterprises and therefore the sort of interface between industry and the institutions will necessarily be the sort of work where they cry for help to fix things rather than, shall we say, establish the basis for a new substrate for an electronic device. It will therefore be much more short term than that. We do have a great opportunity to do things differently in Wales and are so doing. Because we are small we can be very much more nimble. We were fortunate in the fact that our Secretary of State in his letter to us did say that he particularly wanted the research profile to be raised in Wales and he wanted more centres of excellence, so we promptly went back and said, you have got to give us some more money. I am delighted to say that that excellent Secretary of State did in fact respond by giving us £2.25 million to raise the quality over and above the mainstream research funding. We have been very selective and quick with that. The research group asked for bids from the institutions and said, tell us what your best bets are for raising 4s to 5s or whatever it is, give us five or six examples and we will deal with this very quickly. We had bids from eight institutions. We visited them, and I visited seven of them. We saw a cross-section of the very best that the institutions had to offer, we cross-examined them and we said, we are in this together, this is not a you and us situation, we all have a vested interest in raising the quality of research in Wales. I should say, my Lord Chairman, that this was right across the humanities as well although in the event 78 per cent of the funds went into science, medicine and technology so it is largely within the remit of this Committee. We said: we are not particularly concerned about the research content of your proposal, because we are not a research council; we are going to look at the structure of your department, whether having a new chair or a new piece of equipment will help you get to the top very quickly. At the back of our mind was another thing that the Secretary of State said. The Secretary of State said that he wanted us to also have regard to his economic policies, so we were able to feed this in too, and the net result is that that relatively small sum of money, I think, is going to make a tremendous difference. We have actually targeted individuals, we have gone and talked to these people and come back with some really rather good feeling for it. We were able to pick up best practice from one institution and transfer it to another. We could say, well, when we were in Aberystwyth they thought of doing this for local industry, what about you doing this in Wrexham, and that sort of thing. I believe that the smaller regional councils such as Wales and Scotland really do have a tremendous part to play. I have a vested interest in this, of course, my Lord Chairman, because I am a scientist and an industrialist and I should very much like to see a closer relationship between the institutions and industry in Wales without their actually trying to make the widgets for industry. I do not know what the Prime Minister said last night but I do not imagine that he wants the institutions to try to become industrial organisations—at least, I hope not. I believe that the most important thing that the universities and institutions generally can do is to carry out very, very good strategic technology work to create knowledge, and the transfer has to be of knowledge into industry,

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and industry themselves will then go ahead. In Wales there is a great opportunity to do that.

Lord Tombs

484. Sir John, I do not think that you should underrate—and I am sure that you do not—the Welsh universities. I think of Swansea and the spray casting process which was supported by a number of companies, including Rolls-Royce, and it is a world leader, so you can attract from outside Wales and the industrial base need not necessarily be a constraint in that sense. I am particularly associated with the University of Strathclyde in Scotland and I think that the observation of the principals of Scottish universities would certainly not be that bureaucracy has increased—rather the reverse, and that there is now more close and probably sensitive dialogue than was the case before. Whether that is because the client list is smaller than the UFC had or whether it is because the regional considerations pervade the issue, I do not know, but the clients are certainly well satisfied with the early days of the Scottish Funding Council. I wanted to ask a question now of both funding councils. One hopes that regionalisation will produce some diversities, some difference of approach, based on regional considerations and I therefore wonder, young though the councils are, what thoughts they have about the research assessment basis and the way in which they might—or might not—diverge from the English system, if one can call it that, though I prefer to call it, I think, the old UFC system.

(*Professor Sizer*) You have to understand, I think, that for both the funding councils we started with a clean sheet of paper, we had to recruit staff, we have to develop funding models, we had to find premises and all these sorts of things. The important thing was to get some basic funding models in place.

485. Full speed?

(*Professor Sizer*) Yes. We had to get the basic funding models in place and therefore we had in the first instance to use the distribution of research funding that had previously been used by the UFC so we actually inherited "pots" from the UFC, that is to say, pots of overall resources for each of our 72 units of assessment, and we did moderate these a little. However, we really were not in a position, I think, to do much more than that. One of the reasons that I was very keen, and that my council was very keen, to have total openness was that we wanted to expose this so that people could come back and say, look, there is something wrong here. In going forward it is clear that first we want to wait and see what comes out of the White Paper. The council asked for the production of a research policy issues paper and we see that as a major opportunity to have a discussion in the council as to how we respond to the White Paper and to the distinctiveness of Scotland and the priorities that are perceived in Scotland by our community. At the same time, however, my Lord Chairman, I should emphasise that there is a very strong feeling in Scotland that they want to be part of a United Kingdom-wide system so I do not think that there is any pressure to have a local research assessement exercise. We can then consider how to redistribute the pots. It is too early to say how the debate will go other than, like everything else in Scotland so far, I anticipate an open consultative process whereby we do work closely with the sector. The problem that I think that you have to recognise is that within our funding methodologies reflecting the views of the Secretary of State and in the White Paper we are trying not to create massive perturbations in the funding of any one institution. One of the troubles that we have, of course, is that we are locked into a research assessment exercise, into a funding pattern, and if we start making major shifts in that funding pattern between basic and strategic and applied or between various subject areas or creating new priorities, then we are in trouble. In the same way there is a problem, I imagine, in thinking about it nationally in terms of the White Paper. If you are going to put more money into applied research, how are you going to release it? I discussed this with the council and their view I think is the right one, that we should debate a policy issues paper and out of that policy discussion we then revisit our funding model and we refine it.

486. If we have regionalisation I think that it must be for a purpose, and the purpose must be to reflect regional pressures and regional interests. Both Scotland and Wales are fortunate in having a development agency, which England does not enjoy; it has the Department of Trade and Industry to put up with, which is very much more of an antedeluvian sort of organisation than the fast moving outfits in Scotland and Wales. One therefore would expect the concentration of wealth creation and industrial growth in both Scotland and Wales to be greater than in England and one would expect that if regionalisation is to be successful that that pressure would find its way into the thinking of the funding councils. You say that you have to take the remit that is given by government but you also have to feed back into the remit?

(*Professor Sizer*) Yes.

487. You have to advise and try to modify.

(*Professor Sizer*) The advice that we give to the Secretary of State on the public expenditure survey is of course in confidence.

488. I do not want to know the advice; I want to know what you are doing.

(*Professor Sizer*) We have established close links with Scottish Enterprise. On our council we have Mr Ian Wood of the Wood Group, Mr Ronald Miller, the chief executive of Dawson International and John McLelland, the director of manufacturing of IBM, who are very active members of the council. My chairman is a member of the board of Scottish Enterprise. I am establishing close links with industry. Given my own business background and coming from a technological university I have worked at that. In putting the pieces of the jigsaw in place I think that we obviously should like to wait and see what comes out in the White Paper.

Chairman

489. Would Wales like to add anything?

(*Professor Andrews*) My Lord Chairman, I think that the question that Lord Tombs has asked is very important. Our basic starting point in Wales is that

[Chairman *contd.*]

we would hope that the new funding council would give an added quality and added character, but not in a context where higher education turns in on itself and becomes parochial. It is vitally important that in many respects—perhaps in most respects—it remains part of a wider United Kingdom system, and that is particularly true in the measurement of the quality of research. That is why all three funding councils and, indeed, the Northern Ireland Office, are determined that there should be a common research assessment exercise and we should not go our own way. Having said that, my Lord Chairman, I do feel myself that higher education in Wales is an asset that can be tapped to greater effect for the economic and social benefit of the country and we have made it our business over the last year to have very lengthy discussions with representatives of the Welsh Office and the Welsh Development Agency and the chairman and myself are meeting a number of other people over the course of the summer to explore ways in which we can increasingly interface the Higher Education system with public services in Wales and with industry in Wales so that it can play a more substantial part. Outside of the area of research, my Lord Chairman, and this is also important, we have the good fortune in Wales of having a common Executive for the Higher Education Funding Council and the Further Education Funding Council. This is allowing us to create links between further and higher education, which enables things like Access, Outreach and so on to be developed and which I think is going to become increasingly important in the science and technology area where we are going to have natural developments whereby young people who leave school and do not travel on through the traditional A level route may go to further education colleges and follow the HND route into engineering and science. Our ability to interface the two sectors of post 16 education is particularly relevant.

Earl of Selborne

490. Some years ago when I was chairman of a research council I got into deep trouble because we dared to suggest a cut to the Welsh Plant Breeding Station, and the argument that was advanced very forcibly at that time was that Wales had very few research council institutes compared to Scotland, and certainly compared to England. That leads me to ask my question to the Welsh Funding Council. We have had evidence from a number of research councils now and those with institutes have all described how they have restructured over recent years or are proposing to continue to restructure. It is clear that it is of great importance to the funding council to be able to tether some of these research institutes or, indeed, encourage new research institutes where you might say that you are deprived by historical reasons. Are you talking to the research councils along these lines and, if so, have you any reason for optimism?

(*Professor Andrews*) My Lord Chairman, it is a sad fact that there are few research council establishments in Wales. It is an encouraging fact that the Welsh Plant Breeding Station is now bigger and more vigorous than it has ever been in its history . . .

491. As I tried to explain at the time, but no one believed me!

(*Professor Andrews*) The changes there have been enormously successful—we should like to see more. We are in fact meeting—that is, all chief executives and heads of research councils—next week and we ourselves are hoping to arrange meetings individually with the head of each of the research councils over the next two months. There are, I think, some difficulties inevitably arising from the increase in the number of funding councils in respect of the contacts between the funding councils and the research councils. One of the things that we have to talk about is the way in which we can maintain good relationships between three funding councils and the research councils. I think that I should prefer to come back to you in a few months' time and tell you how we have got on with the research councils. We have had an encouraging start with the Economic and Social Research Council, with the chairman particularly, Professor Howard Newby, and we have talked about various ways in which we might improve the quality of research in Wales in ways that would be attractive to that council. We hope that that might be a precedent for talks with other research councils.

Chairman

492. You, Professor Andrews, mentioned your Secretary of State, and I understand his role and the role of the Welsh Development Agency, but there are other departments in the business and there are the research councils and ABRC. What sort of account do you try to take of those bodies in assembling your own views about your priorities for research?

(*Professor Andrews*) My Lord Chairman, at the moment the priority has been very much to improve the quality of research, and that has meant identifying departments' areas of work within the Welsh institutions which are of high quality or which have potential to be of high quality, and to fund those. We hope over the next month or six weeks to have discussions with the heads of the research councils and to explore with them their views of research in Wales and our views of research in Wales, and we hope that we can develop coherent policies.

Lord Porter of Luddenham

493. Do you see it as part of your function to do something different, to disagree from time to time with the research councils? We think, for example, that starter grants for new young people are important, which they do not do. Would you follow the research councils after your discussions or would you try to do the opposite?

(*Professor Andrews*) The fundamental difference that I think I should have with the research councils concerns the number of research establishment that they have in Wales, my Lord Chairman. I think that it is very sad indeed that more of these are not in Wales.

Chairman

494. Yes.

(*Sir John Cadogan*) My Lord Chairman, I think that we should not be particularly concerned about what the priorities of the research councils were even if we were aware of what they are at the moment, because they do change. We are small in Wales; we want to do the very best with what we have got. If I may just pick up something that Lord Tombs said earlier, I hope that I did not suggest that I did not think there was excellent work in Wales, because there is excellent work in Wales; it is just that the Secretary of State wanted more, and we agreed. But we have to start. We think that it is irresponsible to take a series of 1 science departments and think that we are going to turn them into 5s—we want to look at the 3s and the 4s and the 5s—so we have to start from where we are. The historical base in Wales may or may not correspond with the research councils' priorities, and, anyway, research councils' priorities will change. They have certainly changed four times in a major way over the last 12 years and, of course, we have got permanent staff in place, so we would not be very worried about the research council's priorities. We should certainly want to plough our own furrow and to take our own initiative.

Lord Porter of Luddenham

495. Would you recognise that a plurality of funding is almost essential because no single body can get it right? I think to some extent it is your responsibility to fill the gaps that the research councils do not.

(*Professor Andrews*) Exactly, we really do believe that it is important. I am sorry to return to this little pot of extra money that we had, but we really did feel that it was a tremendously interesting step forward, quite unique—it has not happened before.

(*Professor Sizer*) My Lord Chairman, Lady Perry asked about whether we have been too aggressive in our accountability and the use of our funds and I tried to explain that we were not. We distribute those funds selectively essentially on the basis of past performance. The institutional managers then have to decide how to use those funds within the framework of government policy, and it may well be that they wish to distribute them differently. They have then to create the infrastructure within their institutions so that they can interface with the research councils to respond to new research council initiatives. I am not sure quite honestly that the funding councils are the right bodies to decide where the more detailed distribution should take place as far as responding to the research councils and other initiatives is concerned because EC funds, for example, are becoming increasingly involved. We create the infrastructure and we should make sure that it is flexible enough to adapt to the changing priorities not just of the research councils but of all the research funders. I think in the end it is for institutional management to respond to this, but within the broad framework of accountability, given that it is clear that the Government wishes funds to be used to support the best and within the broad framework of their policies.

Chairman

496. The part that research councils and the like cannot do, is to support the bright young thing who has not yet reached the stage where he or she can go to a research council or to a government department and get support and if anyone can support these young people it must be the funding councils. What are you doing about it?

(*Professor Sizer*) I should explain, about the element of our income model where 5 per cent is distributed on the basis of income generated by the departments in the 1 and 2 categories, that we are not saying to the institutions, we expect that money to be distributed that way; we are saying, this is a fund that is available to vice chancellors and principals in order to support emerging areas of priority, the sort of green shoots, as you say, that are not yet ready to be taken up by research councils and others.

Lord Porter of Luddenham

497. You say, support emerging areas; we are talking about supporting young individual people who have their own opinions about priorities.

(*Professor Sizer*) I do not think that we can provide funds direct to individuals, but what we should assume is that if you have the right sort of person leading an institution and it is properly managed the vice chancellors will want to distribute these funds to support in some cases individuals, in some cases groups, because, as you know, a lot of people these days have to work in groups. That is the limit at the moment, I think, to what we can do within our broad task.

Chairman

498. Are you making it clear to vice chancellors and principals that you have put that duty upon them?

(*Professor Sizer*) Yes, absolutely clear. We have just issued a request to institutions asking them how they are going to use the money, not in respect of funding particular projects but how they are going to use their managerial discretion to do the very things to which Lord Porter has referred.

Lord Butterworth

499. I am a little anxious about this concentration on the vice chancellors. By their constitutions the academic sovereign is the senate.

(*Professor Sizer*) Yes.

500. Are you satisfied that the structure that you are setting up will empower senates, probably led by their vice chancelllors, to be able to take an initiative in some area that they regard as being important for that institution? Have they enough discretion left to be able to do this?

(*Professor Sizer*) The Jarrett report, of course, has had a significant impact on the relative balance between senates and councils in the distribution of resources. When I was talking about research accountability I remember that I stressed that we were interested in the processes whereby research resources were managed, and we should expect to see, particularly in the large institutions, a research committee, probably a joint committee of the senate and council, where that committee would make

[Lord Butterworth *contd.*]

recommendations on policy. While the vice chancellor is making input in that I should assume this is a part of the management process. I think that I earlier used the term "management", and when I used that term I was using it in the plural rather than in the singular.

501. Is there anything that either of you would like to say about the dual funding system, the handing over of funds from the institution to the research councils? Has it damaged that responsibility of the institutions or would you prefer to see it go further, that is, would you prefer to see more funds handed over to research councils? Is the dual funding system now in a situation particularly where the institutions can support young staff?

(*Professor Andrews*) Personally, my Lord Chairman, I think that the maintenance of the dual funding system is vital, and I think that there are dangers that we will take selectivity to a point beyond what is desirable for the system as a whole. I say that because the system of selectivity that we have now has effectively got a ratchet built into it. The departments who are rated 5 will grow in volume and by growing in volume they will take more and more money from the system. When one is looking at the funding council money, yes, it is important for the support of young scholars, but I think that it goes beyond that. It is the money that protects the research environment within the higher education institutions. It is the core provision, it is the provision that enables the department to continue between one project and another when there may be a fallow period in the money that is coming in from the research councils; it is the money that enables the department to experiment, to go off, not on frolics of its own, but on research ideas of its own which at that point in time will not tempt the research councils; and it is the money that enables the department to build up research teams, to encourage young scholars, to take on post doctoral research fellows, to nurture young lecturers. And it is absolutely vital that that continue. I think that if you move money away further to the research councils you will pay a heavy price, not just in the higher education institutions but as a nation in losing that secure base for university research. That having been said, it is not the function of the funding council to manage institutions. We can only fund institutions and encourage the institutions to do what is in the best interests of fostering research within themselves and, one hopes, to have regard to the intermediate term. One possible disadvantage of the repeated research assessment exercise is that, not only does it encourage institutions or individuals perhaps to publish in the short term in order to score next time round, but it often encourages institutions to try to recruit relatively senior people from other institutions who will bring with them publications and score in the next research assessment exercise. Therefore, while I support selectivity, and I think that there are great advantages in the research assessment exercises because they do sort out departments and they do bring home truths to people, none the less there are some corresponding disadvantages in that there is a danger that we will not be looking to the day after tomorrow in the research world.

Chairman

502. Without trying to manage, you could issue a policy statement that it is your wish that institutions should make special provision for backing bright young things, for example. Have you done that? Is there any reason why you could not?

(*Professor Andrews*) There is no reason why we could not, my Lord Chairman. We have not done it, but I think that the suggestion is an interesting one.

(*Professor Sizer*) My Lord Chairman, I think that these are the sorts of issues that we will address in our research policy paper that we are currently preparing. I do not have a lot to add about the dual support system. I think that we have all been round this loop many times before. One of the things that I think we should also not lose sight of is that when you are funding infrastructure you are essentially funding period or fixed costs of the university. Once you move from funding through the funding council to funding through specific grants then effectively you are turning hard money into soft money and you are replacing reliable sources of income with more variable sources of income, out of which you are having to meet costs so that it is difficult to turn off the tap. I think therefore there is a very strong case from the financial stability point of view of the system to ensure that these infrastructure costs are met through annual grant rather than through support for specific projects. As far as the existing transfer is concerned it is too early for us to say whether it has caused any damage, but it is clear that if there were significant changes in the way that the research councils distributed the transferred money then it could obviously have a damaging effect on the sector. However, I do know that the research councils are monitoring this very carefully and they keep giving us assurances that their intent is that it should be distributed in the way that the Government intended.

Lord Porter of Luddenham

503. My Lord Chairman, Professor Andrews gave an admirable list of very good reasons and Sir John Cadogan as well, for not transferring further money to the research councils. There is one counter argument that one hears, and that is that in fact the universities do not spend that money allocated to research on research and therefore it would be safer from a research point of view to hand it to the research councils. What assurance do you have that those admirable applications of your money are in fact forwarded by the universities in Wales and Scotland?

(*Professor Andrews*) My Lord Chairman, I suppose that ultimately the test is the selectivity exercise itself in that if the institutions are not producing research of quality then they will no longer get the money the next time round. The subsidiary question to that is no simply the outturn, the quality of the work which earns the money, but the more specific issue of accountability, of how the money is actually used and showing that it is spent on research. As you will know, the funding councils are at the moment exploring with the institutions how they might pursue this issue of accountability. I think that there is a very real problem. Attention has been drawn to the amount of paperwork in the system. If

[Lord Porter of Luddenham *contd.*]

we are to ensure accountability for research funding there is a danger that we will be putting considerable pressure on the institutions, at one extreme even by people having to keep diaries to account for their time, and I think that this is a problem. You cannot have strict accountability for funding without as a corollary rather a lot of heavy bureaucracy.

(*Professor Sizer*) My Lord Chairman, if we can satisfy ourselves about the way the institution manages its research and if they can tell us about how their actual allocations match the allocations from the council this may avoid going along the road of going to a full costing model where people keep diaries.

504. In your view is there anything in the argument that has been put forward largely by the research councils that money is safe in their hands because it will really go into research?

(*Professor Sizer*) Well, it may well be in some cases that you could argue that teaching money has been used for research purposes. If you have as we have to date a funding model that has been driven by research selectivity on the research side but no quality assessment on the teaching side, if anything there is a pressure if you are trying to improve your rating to use more of your resources for research, and that is why of course we are now in the process of producing quality assessments for teaching. In Scotland on 14 June we will be announcing the first quality assessments in the areas of economics and electrical and electronic engineering to create the necessary balance. Therefore, there are two sides to these arguments.

Chairman

505. I can never understand why it needed four or five years to find that out; it was obvious from the beginning.

(*Professor Andrews*) My Lord Chairman, may I add one other point on this, and that is that the money that we put into institutions to support research has a leverage in that it provides a research base on which the institutions themselves can go out and get additional money, whether it is from charities, from Europe, from industry, from the professions or simply by people working overtime and working long weekends and so on, which the research council funding does not. That is geared for a specific project and it has no leverage.

Lord Tombs

506. That brings us to the question, do you identify and reinforce that tendency?

(*Professor Andrews*) The leverage tendency? Oh, yes, indeed.

(*Professor Sizer*) Through our research funding model.

507. So you have in mind accentuating that inward strength?

(*Professor Sizer*) I think again if there is a clear steer as a result of the White Paper then the lever is there to do this. We have to be careful at the moment to operate within the rules as they are.

508. I hope that you are not too careful!

(*Professor Sizer*) Well, we do our best.

Baroness Perry of Southwark

509. The priorities within the institution may be very different and may run counter to the priorities of the research councils or the priorities of the funding councils from outside. The priorities in the instutitions are to maximise your income by whatever means. I am sure that Professor Sizer particularly as a mathematician will be well aware of the importance of the balance between the volume factor and the step factor, and if the step factor is relatively small it is clear that it will be to the institutions' own advantage to multiply the volume as much as possible, in other words, it would be better to end up with 15 2s than with 3 5s, for example: if you had 80 per cent of your staff operating at a 2 level you would be bringing in more income than if you had 10 per cent of your staff operating at the 5 level. Now that in terms of the priorities for the overall United Kingdom science base might be very bad, but it would be certain to provide the financial incentive to the institution and in some cases provide a strong pedagogical argument. Many institutions feel that they cannot afford to lose a research base in every department because it would have a very disadvantageous effect on the teaching. How do you believe that as funding councils you can provide a methodology that gives an incentive towards institutions to behave in ways that actually support the overall strategies of United Kingdom science nationally?

(*Professor Sizer*) My Lord Chairman, I think that your problem is a problem more in the J minus 1 model than in the one that we use. With the J minus 1 model you get uneven incentives. Therefore, you get a 100 per cent increase between a 2 and a 3, a 50 per cent increase between a 3 and a 4, and a 33⅓ per cent increase between a 4 and a 5. This in fact was one of the reasons why the Scottish council felt that it was not a logical model because, as you say, it tends to send messages that you get the most significant increase between a 2 and a 3. Therefore, we settled on a 40 per cent step model. On the other hand, my Lord Chairman, if we actually had a more aggressive model the other way so that you had big steps at the other end then you run into the problem Professor Andrews mentioned, that there is a danger of ossification. Green shoots do not appear necessarily always in the best departments. We all know that. We try therefore to get a balance. We look to the institutional managements not to divert funds in order to build up their 2s. On the other hand, however, we do not want simply to finish up with a system that supports only a limited number of departments for the reasons that you state. As a funding council I think that we have to observe what happens and then we have to respond. I think that it is too early for us actually to say specifically how we deal with it, my Lord Chairman, but that was one of the major reasons why we went for the 40 per cent step model rather than the J minus 1 model. It seemed to the council and to the executive to be illogical and encourages the very practice that, as you say, could be damaging to the science base.

[Baroness Perry of Southwark *contd.*]

(*Professor Andrews*) My Lord Chairman, I am not sure that I am so convinced by that. In large measure I think that institutions' self interest will encourage them to put the funding into their best departments. They are not going to want to lose their 4s and their 5s. The amount of money that is being drawn into the departments rated 2 is relatively small; and, of course, departments rated 1 will bring in no funding at all. The impression that I have, my Lord Chairman, is that the institutions are now beginning to realise the importance of encouraging—and I do not like using the phrase, but it is commonly used now—centres of excellence. We have a research group that will be looking at ways of encouraging research in Wales. One of the factors that it will be addressing is how to promote and encourage centres of excellence. We will also be talking to our institutions in connection with their strategic plans. I have little doubt that one of the things that is going to emerge over this is that we will want assurances from our institutions that they will be funding their 4s and their 5s to ensure that they stay 5s and, if they are 4s, either that they stay 4s or that they become 5s. We will also want to be knowing from them what they are doing to other areas, 3s, and occasionally 2s, where there is some reason for potential growth. As you know, the exercise was done on a snapshot on 30 June 1992, and there are occasional 2s that are there by pure misfortune. We will want to talk to them about how they may also become centres of excellence. However, where any institution says to us, "we want to encourage research across the board, this is our basic mission and we do not want to distinguish one unit from the other", I think we would not be very impressed with it.

Chairman

510. You are saying either explicitly or at any rate implicitly you accept something on the lines of R-X-T?

(*Professor Andrews*) Within the Welsh higher education spectrum I think that there are a number of institutions which have always been teaching institutions, the former public sector institutions, and although we have a small amount of money for DevR for those institutions the size of the money and our determination that it will be distributed selectively will inevitably mean that there will be a significant number of institutions that remain teaching institutions. Within the other institutions that traditionally have had a mixed teaching and research economy I think it is now recognised as increasingly inevitable that there will be some areas within those institutions that will be very largely teaching. Though I would be very hesitant to say that they would be only teaching because it does seem to me to be a basic given right of any person in or outside higher education to pursue research if he or she so wishes and if he or she is so able.

511. I am conscious that many of the things about which we have been talking are national things really. I just wonder whether you feel that there is anything that you should have said of a particularly Welsh or Scottish character that you have not had a chance to say; and, if so, now is the chance to say it.

(*Professor Andrews*) My Lord Chairman, the only thing that I should like to say is—and I think that this would go for Scotland as well—that the councils have been in existence for one year only and we have been funding for one month only. We have learnt a lot during the first year and we have faced a very steep learning curve. We have, I think, made a very considerable amount of progress, but inevitably it is going to be two, three or four years from now before the full development will be seen and before the new character of higher education in Wales and in Scotland in its richness will be emerging.

512. And Scotland?

(*Professor Sizer*) My Lord Chairman, any new body has to earn its spurs before it starts taking major initiatives. It was important, I think, both in Scotland and in Wales that new bodies with new secretariats, and particularly in my case no people from the existing UFC Executive, could demonstrate that we could produce effective funding models and establish credibility and then begin to take some initiatives. The members of the council, some of whom it is clear would have liked to take some initiatives earlier, I think now recognise that it is important to hear the sort of statement that Lord Tombs made. Now that we have established credibility in our funding decisions, we can look forward. Next month we will publish our quality assessments of teaching, the first in this format in the United Kingdom, in Europe and possibly in the world. If we can establish equal credibility on that part of our activity then I think the council can start to look forward in the way that you would like us to.

Chairman: Thank you all very much for coming and giving us a very interesting afternoon. We wish you both every success in the future.

Letter from the Higher Education Funding Council for Wales

"We understand the HEFCE allocates QR among the Units of Assessment (disciplines) in proportion to historical provision. Do you do the same? How do you justify the historical imprint which this practice places on your allocations?"

The allocation of QR amongst the Units of Assessment was in proportion to the UFC's distibution for 1992–93. This distribution in turn reflected historical provision in that it was based on the existing pattern of spending of UFC resources on research within the universities themselves. This mirrors the approach adopted by HEFCE. However HEFCE also took account of the relatively small amount of research funding which the PCFC distributed. This latter step was not taken by HEFCW because no such funds were allocated to former public sector institutions in Wales. Accordingly in Wales the sums associated with Units of Assessment reflect UFC distributions alone.

The use of historical data is justified on two counts. Firstly to do otherwise would have required the Council to determine the distributions itself and at this early stage it would have been extremely difficult to gather the relevant data which would underpin this determination. Secondly the use of existing patterns of spending effectively means that weight is given to judgements made by the institutions themselves. This in itself can be regarded as a good reason for continuing with this approach.

However, the matter is being given consideration by the Funding Councils with a view to identifying whether any anomalies have been inherited.

"In England, the inclusion of the new universities tips the balance of volume of research away from medicine, science and engineering, towards non-science disciplines. Is the same true in your region? Is it your job to do anything about it, and if so what?"

The amount of research funding that has been directed to former public sector institutions is small. Thus of the total of £33.76 million made available for QR some £350,000 was allocated to former public sector institutions, so the effect of the inclusion of these institutions is marginal. As it happens the balance of medicine/science/engineering funding is virtually the same at the former public sector institutions as at the former UFC institutions (approximately 65 per cent of total funding).

7 June 1993

WEDNESDAY 26 MAY 1993

Present:

Butterworth, L.
Chorley, L.
Dainton, L. (in the Chair)
Dean of Beswick, L.
Porter of Luddenham, L.

Examination of witness

Professor Sir Geoffrey Allen, FRS, was called in and examined.

Chairman

513. Sir Geoffrey, we are very grateful to you for coming and putting at our disposal your great wealth of experience first as an academic at Manchester 1965-75 and Imperial College 1975-81, and secondly as chairman of the Science and Engineering Research Council 1977-81, during an interesting phase of its life. We also have the benefit of your long experience in industry with Unilever, where you were Head of Research 1981-90, and now as Executive Adviser to Kobe Steel in Japan.

(*Professor Sir Geoffrey Allen*) My Lord Chairman, I should like to begin by making three very brief comments about the science base and the priorities that people set for it. First, it seems to me that in the science base of any country the real issue is whether it attracts top-quality people. Whatever be the priorities that one sets, that must be the first one. Secondly, one has to consider the priorities for managing the science base. If I look at the United Kingdom in its present form, I believe that the priority is not just to keep the dual support system in its present damaged state but to restore it to a full state. To my mind, this means having well found laboratories within the universities, supported by the University Funding Council and than have research councils that invest in that science base and promote the activities that they deem to be either of great merit for the nation or of particular interest to the national industries. The third point I make about the science base concerns the industrial view. It is fairly well accepted among research directors in industry that what they want to see in the science base is not so much particular topics. In the United Kingdom they would like to see a science base of international quality with international people taking part in it. Six months ago I chaired a meeting between 12 research directors from British chemical companies. That was the first message that they gave to the Chemistry Committee of SERC; they were not so worried about the detailed programme but about the quality of the people and how their work ranked internationally. They did not expect our scientists to be in every area but did expect them to be of world repute in some. I think that by and large industry—even manufacturing—would make the same point. I believe that industry sets priority on the people coming out of the science base rather than on the transfer of technology, though the second is very welcome. I am afraid that is rather an old-fashioned view of the science base, but it is interesting to see industry in quite a difficult situation coming back to that view.

514. We have been told that interestingly there has been maintenance of investment in people in many industries despite the recession?

A. I think that it is patchy. I am sure that the bigger companies have maintained their investment. I have to say that a lot of medium size companies and some of the smaller research-oriented companies have not. What is more, the level in some of those industries was low to begin with. I think that we have a rather distorted R&D base in industry. From the point of view of the science base generally, I believe it has to be accepted that that base is now very much in the universities. There are very few basic research institutes left in this country and it is up to the universities to maintain that base. Having said that, the worry when looking across industry broadly is that the science base inside industry is now too small and patchy. The receiver mechanism for connecting up with the national science base is not as strong as it ought to be.

515. Does it also follow that when universities out of financial exigency go out to earn funds which are rather towards the applied and near market end you regard that as a departure from their proper vocation, if the balance goes too far that way?

A. Yes. It is a matter of the balance rather than propriety versus impropriety. For people in the science base to join up with a company and help them solve a problem is a very beneficial experience. The experience that one brings back into the science base is valuable, but it ought not to be a way of life.

516. I suppose that one is producing two things from the universities. First, one is producing people, "ideas on the hoof". In a sense that is a job for the future?

A. Yes.

517. The other is a close linkage (in which neither forgets its identity) between industry and the universities?

A. Yes.

518. Industry is a very mixed bag, as you have hinted. One of our concerns has been that the small, medium size enterprises that are scientifically based are rather at risk at the moment partly because of their lack of contact with the universities. That is another force which tends to draw universities and such enterprises together. In principle that is a good thing, but it is yet another force which perhaps distracts attention from the primary function of universities.

A. Yes, it does. It is at risk in another sense. Many small companies do not have people in influential positions who really understand how to make the

[Chairman *contd.*]

best use of the science base. Partnerships based on misunderstandings are very serious problems.

519. You are an example of a very good partnership between the University of Manchester and ICI which was formed nearly 30 years ago and was a very successful one. We ask ourselves questions about how decisions are taken about the science base and how organisations do it. Have you any observations on that?

A. In the United Kingdom the influences over the decisions come from various quarters. Certainly, when I was chairman of the Science Research Council I reported directly to the Secretary of State, who at that time was Mrs Williams. I have to say that in her two years it was the only period in which all the chairmen of the research councils met together in the presence of the Secretary of State. That has now disappeared from the system, according to my understanding. The real focus of the influence on the science base has been dissipated. On the other hand, if one is influenced from separate quarters to set the priorities they want, it is an advantage provided all the research councils have a mechanism for meeting together and discussing the priorities. The danger with fragmented advice and attempts to produce priorities in fragmentation is that one research council sets off in one direction and another in a different direction. It does not matter that they go in different directions, but the problems of coming together and producing a uniform programme are exacerbated by it.

520. When the Council for Scientific Policy was set up in 1964 and two new research councils were introduced, and later when the ABRC was established in 1971 or 1972, the idea was that those bodies should provide strategic guidance to the research councils which would have muscle in the sense that it would advise the Secretary of State on the amounts of money each would have year by year. Is that arrangement, which amongst other matters is at present under scrutiny by Mr Waldegrave, a satisfactory one or do you think it should be improved?

A. I think that it has to be improved. In my experience, there were five heads of research councils in what is now ABRC and several independent members. The weakness of the independent members was that each was seen to have an affiliation to one of the research councils. It was very difficult to rise above that. The other point is that I do not think that the advisory mechanism made enough use of the independents meeting in private and then coming back to discuss with the heads of research councils. I found that disappointing. This is the way to get real advice. The other thing that is missing from the system is that we do not have a view of what the national priorities are in industry as related to technology. I believe that it can be done very simply. I do not think we have to have a big study about which areas of technology are burgeoning and which we should cut back. I think it would be very simple for the DTI to scrutinise the many reports from this and other countries about important technological themes and to get together a few companies with the help of CBI and draw a very coarse map of the technologically important things. One then needs something from the public sector to say what is needed from medicine, and so on. I believe that a picture like that, put together, would be of great value to a board of research councils.

521. You are referring to the research foresight map?

A. Yes, but not too much foresight. It can deal with quite a few things that are regarded as contemporary. One does not have to do a lot of crystal-ball gazing.

522. Earlier on you talked about your strong support for the dual support system. I imagine you will know that money was recently transferred from the university vote, which comes through the Department for Education, which replaced the Department of Education and Science, to the research councils. That means that universities have correspondingly less free resources to devote purely to research when they have taken care of their teaching and other commitments with their funds. First, does that problem seem to you to be a real one? Secondly, are you surprised that the head of the funding council is no longer on the ABRC and there seems not to be a formal connection between them?

A. My first statement was that I wanted to see the dual support system restored. This is one feature that I would lead with. I think it was an unfortunate thing to move the money from the University Funding Council into the research councils. The problems that the research councils had in allocating that money and the way it was fragmented far exceeded the value that one got by the broad-brush approach of the University Grants Committee. The U.G.C. had a very effective way of using the money, and putting it into the universities for them to decide where it went. If we want to get back to well found laboratories it is essential to transfer that money back and a little more. It is essential to have the chief executive, not the chairman, of the Higher Education Funding Council as an independent member of the advisory board or the board of the research councils. We can only gain from that.

523. I believe that we all share that feeling. Another problem that universities and some of the research councils speak about is that which concerns the junior but very good researcher who in these circumstances perhaps finds it difficult to make his way as a researcher to the stage at which he can apply successfully to a research council for a significant grant. Is that something of which you have experience?

A. Yes. It is something that concerns many of my friends in industry. This is now a weakness in the system. I have changed my view on this matter to some extent. I believe that at times when funds are more readily available, the universities can take care of the issue, but at present they cannot because of the stringency in funding that has been mentioned. The research councils are not good at developing young people; they are much better at getting programmes done, managing them and—very importantly for Britain—linking us into the international scene. One of the priorities for the science base must be to have strong links worldwide. My view has changed somewhat. I believe that, having sat on the Royal Society Fellowships Committee and dealt with junior

[Chairman *contd.*]

fellowships, it is something that the Royal Society, the Royal Academy of Engineering and the medical colleges can do very well. They can look after the pool of very promising young people, thinking about them as people rather than scientists or engineers who will do a job and help with a programme. We have to grow them in their own right with their own sense of values so they are able to make their own judgments. If I could make a change at the moment I would give the Royal Society 100 fellowships, not 50. I am most impressed by the way they give them out. I am very impressed by the way in which they follow up the people in post. Now that we have a concordance between the Academy of Engineering, medical colleges, the Royal Society and, I hope, the British Academy—since it goes wider than science and technology—we can use them to look after this particular aspect of our educational base.

524. What you said a little earlier about foresight surprised me in the sense that you had such wide experience of Japan where it seemed to me that MITI, Monbusho and industry worked closely together in producing what appeared to be very much a top-down system. Is that a misunderstanding on my part?

A. Not at all. But one has to understand that whilst the Japanese think about bottom up and top down they think about each equally strongly. Wherever we recognise a top-down system I can assure you that there is a very strong bottom up activity as well. One of our problems, true of most western countries, is that we get one or the other but rarely get the two in concert. This is one of the joys of working with Japanese companies. I can switch easily from talking to the Company President and the Vice-President for research to going to a laboratory and talking on the same topic to get a wide range of views from that laboratory. The president and vice-president will know what the consensus is. They will wait until that becomes clear. The Japanese system is interesting in the following respect, that MITI orchestrates the national science and technology programme; it does not really try to shape the science base. It looks at what the nation needs in terms of manufacturing, social services and so on. It concentrates on that. I think it does something which the DTI have lost the knack of doing. It can then engage sectors of industry in a very profitable collaboration. By the time that MITI says, "These are the themes that we will endorse next year", industry is behind it. There is no further debate as to whether or not it is sensible—unlike a lot of the difficult arguments that we get in Britain post the decisions.

Lord Chorley

525. How does that differ from picking winners?

A. MITI does not pick winners; it will pick broad areas in which Japan would like to be excellent. The companies pick the winners. That is the secret.

Lord Porter of Luddenham

526. Is not the difference that such a large proportion of the best effective research in Japan is done in industry as opposed to the universities whereas that is not true of our research? Is it not true that MITI is orchestrating research in industry and not so much in the universities?

A. Absolutely. I wish that in many of our schemes where universities are prevailed upon to help industry it was the other way round so that industry is encouraged to help itself using the science base to support it and provide people and skills in the gaps that a particular company may have.

527. When you gave as your solution that the DTI could quite easily gather together information from overseas about national priorities for research you were talking mainly about industry?

A. Very much so. On the one hand one has the CBI and industry providing information and the DTI conducts the orchestra; it does not tell industry what it should do.

Lord Porter of Luddenham] I am not sure that we are not excluded from considering this in a way by our terms of reference: by "science base" we mean research carried out by universities and research councils.

Chairman

528. We cannot divide a continuum.

A. Absolutely not.

529. But the witness must not feel restricted or prevented from making observations which bear on the science base that are based on experience outside.

A. I did take the liberty of ignoring that part of it!

530. Perhaps I can bring you back to Britain with your Japanese experience behind you. At the time of which you spoke when we had a good dual support system, well found laboratories and universities able to deploy some resources, the research councils were reasonably well funded. The total amount of money as a percentage of GDP was larger than it is now.

A. Yes.

Chairman] What has happened now is that in a sense the capacity of the system to do research with its attached costs has come up against the limit that the Government have imposed through the popular will, as it were. But there has also been a great expansion in the number of higher educational institutions. There is also a possibility, made explicit by the ABRC some time ago, of research, and teaching intermediate universities. Do you see those two factors, namely, an increase in numbers and a tendency towards RTX-ing in one form of another, creating special problems for the science base, and how is it to be managed?

Lord Butterworth

531. Before the witness answers perhaps I may add a third consideration. I am referring to regionalisation, as we call it—the Scots are not happy with that word, as you will understand—of the funding councils. All of the things that the Lord Chairman has just said seem to depend on the solution. The solution that I would like to hear from you is much more about the contribution of the DTI.

A. Perhaps I can separate the DTI from the regionalisation of the research councils and then go back to the Lord Chairman's questions. I think that in terms of the university part of the science base,

[Lord Butterworth *contd.*]

particularly the seedcorn part, regionalisation is not a big issue. In effect we would give money to the universities and they would judge how to use it best. Wherever the good people are that is where the money should go. It would not be a great embarrassment to have Scotland, Wales and England deciding these things separately because at the end of the day most of the decisions are in the hands of those who are to do the work. If we turn to the increase in the number of students and the RTX situation, first I never liked the RTX scheme. But we have to be realistic. Ideally, I would like to see a greater proportion of our children going into universities, not just for wealth creation but that at the end of the day to have a better educated electorate is a good thing. The only way to protect the science base if one has a large number of students coming through the universities is to have some institutes which do both teaching and research and to support them fully to make sure that it is where the continuity and coherence of the science base lies. As to the middle layer, of course there will be some good people there and no doubt the best of them will want to go into division one where they are in a burgeoning environment. I think we have to accept that if we are to take a lot of people into further education there will be a third layer which will be mainly teaching. But I do not much mind whether that is the conventional kind of university or a development of the Open University. I believe there is a lot of merit in mature students learning whilst they are doing a job and integrating the learning with the job. As a matter of fact, I think that it will be very good for managers in industry to have to look after the further education of their people. It would develop a rapport with those people of the kind that does not often happen nowadays given the pressures on people in, say, manufacturing industry. I think that it would be altogether beneficial if we could develop not just normal teaching colleges but a wider concept of further education for mature students.

Chairman

532. You are also here in a sense as chairman of the Council of Science and Technology Institutes?

A. I do wear that hat.

533. You have very kindly sent us CSTI's submission on the White Paper. One could not fail to notice the strong emphasis there on looking at the whole age range. You particularly mention a broad range of studies for school leavers; you mention problems of manpower. You also mention that it is particularly important for those in the science base to have a long planning horizon and strategy. Perhaps you would expand on that because I believe you are the first person who has been so explicit. I understand that those are the views of your member institutions by and large.

A. Yes. One has to recognise that CSTI is a bit like the science base; it is a collection of individuals in different institutions who with difficulty come together and express some coherence. We think that these points are very important and not sufficiently well developed in the United Kingdom. People do not give enough attention to them, particularly the last point you make. We hope to take part in that in various ways and create a forum. We also believe that we have to work with the British Association and the Royal Society to develop the arguments.

534. I suppose you would strongly feel that you would be educating a lot of people in science simply because they were citizens, but for those who became professional scientists would you see a need to change the undergraduate course in order for some to proceed to a master's degree, as some have argued?

A. What we feel is that in the later years at school there ought to be a broad A-level course. I think most of us would opt for five subjects. I would opt for six. I would certainly want to see science, humanities and a foreign language as part of that education. That is where we would start. We find it very difficult to accept that a reasonably good bachelor's course can be provided in less than three years. I think that we would prefer three plus one to two plus two. That would be the considered opinion round the table.

535. There are some who argue that if a subject is really advancing what you say about it gets less and less, not more and more, because the facts are comprehended by fewer but more encompassing theories!

A. Indeed. I think that people do not give enough credit for the amount of learning that occurs between students rather than between staff and students. I think that that is always a hedge against those problems. I go back to the long planning horizon. I feel that it would be of great benefit to the science base to try to persuade the Higher Education Funding Council to think long term again. I do not believe that we are in a situation where any government will impose swingeing cuts on the science vote. Therefore, given that the vote for the Higher Education Funding Council may vary at most by about 1 or 2 per cent each year I do not see why they cannot go back to the quinquennial system where a ring is put around, say, 80 per cent of the money which they are pretty sure they will get and then deal with the 20 per cent and let the universities have a go at long-term planning again. As a matter of fact, I believe that the turbulence of the past 10 years means that the universities will be in a much better position to do long-term planning than they were when they did not have those problems. I think that they will have learnt a few lessons. The worry that I have is that in the past 10 years people in universities have rather rolled with the punches and gone in whichever direction they have been pushed. I believe that if they do get that measure of freedom to think long term they have to stand up and be counted and decide what they stand for and where the skills are that they want to develop in their own institutions.

536. You do not need to hold back a lot of money at the centre in order to be able to steer the system, because people are very responsive to a little money at the margin?

A. Very much so. I ran SERC that way, if I may disclose it. I think that what often goes wrong with these councils is that they do all the indexing and tell each committee what the index will be in the following year. I never did that. We did the indexing and that was the free money that we had to distribute. We used to do our forward look on last year's figures

[Chairman *contd.*]

and then get the settlement. There would only be £10 million or so extra, but it made a tremendous impact on what you could do. People believed that we got the money out of thin air but we did not; it was just the way we worked it.

537. One of the points that has been represented to us by the research councils themselves is the fragility of the science base in so far as it is dependent upon an increased proportion of part-timers in posts of limited duration. In the past 10 years they have multiplied two or three fold. It is said that that is really no way to conduct the system. Do you regard that as a valid criticism? Would it be part of the new policy? We are all waiting to hear what Mr Waldegrave has to say. Do you think that something should be done about it?

A. It is a question of balance. I think that we need people in short-term posts who can stay on in universities and get further experience of research. I believe it is very wrong to encourage them to stay on for ever. Certainly, in SERC we imposed a limit of six years on the length of time that a person could hold a post-doctoral research fellowship. I believe that it is the duty of the science base to offer people to other functions in the country: industry is one and public service another. There is merit in some short-term appointments. In some respects I believe they are essential. I am not so sure about part-time appointments. One needs to have a very good local system to cope with part-time posts. In general, I do not believe that one can say that they are good or bad things. They work well in some places. I lived in a part-time system for five years and it worked very well. Both Sir William Mansfield-Cooper at Manchester and the head of the ICI laboratory made sure that I could live in the two worlds and supported me enormously. One needs that kind of local arrangement.

538. That was a specially good arrangement in the sense that it was deliberately trying to build a bridge between a great university institution and a great industry. I think that we would tend to classify that as full-time and in a good cause.

A. Yes. I have seen part-time appointments work very well in Germany and Holland. The way they are set up in those cases means that both sides fully support them. I think that often the problem we have with part-time appointments is that no-one takes them very seriously and full support is not given. It is much more difficult to work part-time than full-time.

Lord Porter of Luddenham

539. Our problem as I see it is how the priorities are to be set. Sir Geoffrey has talked about industry and how the DTI can help further. When we come to basic research in universities I think we are all agreed that as far as possible we should leave it to the researchers to decide on the detail.

A. Yes.

540. But we are then stuck with the main problem of the broad distribution of priorities as between big science—astronomy, nuclear physics—and physical chemistry and biology, and perhaps engineering. Who is going to do that? Where can we get advice on the relative importance of these things? There are not very many individuals operating at that level. Mention was made of the Royal Society and the Fellowship of Engineering as being an obviously useful body for choosing fellowships. You are a vice-president of the Royal Society. Wearing that particular hat, do you think that the Royal Society, Fellowship of Engineering and British Academy have a role to play alongside whatever is left after Mr Waldegrave has had a go at it in advising us all on priorities? My next question is that I believe you were almost entirely responsible for changing the SRC to the SERC?

A. Yes.

541. Still talking only about the setting of priorities, is it now easier to decide the relative importance of engineering and science as far as funding is concerned? Engineering has done very well on the whole; it gets a much bigger slice of the cake than it did. Is it better to do that, or would you advise a separate arrangement for engineering? There is talk about big and small science being divided into two separate research councils. Would it be better if engineering and science had separate councils?

A. First, as to the question of setting priorities I have talked about the science base and the fact that it should be left to individuals. I have talked about the value of having a national map with industry subscribing to it in the sense of saying which technologies are useful now and will be useful in future. I have not talked about setting priorities at the research council level. I suppose that that will be the main subject of today's White Paper. I believe that the Royal Society and Royal Academy ought to be more involved with "people" things than "programme" things. As bodies I would use them to deal with "people" issues, like looking after the young fellows. I think they are ideal for that purpose. I would not ask the Royal Society to decide the level of big science versus little science. I would use a more heterogeneous group for that purpose.

542. Like what?

A. In the end the Advisory Board for the Research Councils was not able to do it. We need to look at that mechanism. I believe that that body has to have representatives from the public and private sector, because they represent national interests, and the science base itself, that is, the dual support part of the science base. There is no reason why we cannot set priorities for science within that provided that the group is broad enough. Fragmentation of that group is disastrous because that is how big errors of judgment are made collectively. If we had a group of about 12 people I believe that that could be done. I like the Science Council of Japan. On that body are four or five people of the equivalent of secretaries of state. They give the national priorities for industry. There are then five or six independent people who have time to lead the studies that their deliberations throw up. Judgments are made on the basis of individual studies.

543. Perhaps I am over-stating it or being over-confident, but on the whole if you tell me who those 12 people are I can tell you what the result will be. I can count the number of astronomers and nuclear physicists and I can count the number of biologists

[Lord Porter of Luddenham *contd.*]

and chemists. This is the problem with royal societies. If you ask them to do it you can predict the result.

A. Indeed. I believe that one has to think of a chairman. I am afraid that personalities begin to intrude when one looks for a balance in a decision-making group like that. The group has to have the will to make a decision. For many years I have thought that a mission-oriented big science council would be a good thing. We could put a ring round the international subscriptions and negotiate them separately, but I am conscious of the point you make. They would be isolated in the broader ranging debate and would be more likely to be cut than when they were part of SERC. The same thing goes for engineering and science. If one was not careful one could have a group that was not balanced. We had that problem in SRC as it evolved towards SERC. The board was roughly a third from industry, a third from the public sector and slightly more than a third from universities. I think that we worked rather well together. One could take small groups out of the council and come back to it with considered proposals.

544. In a word, you would keep SERC rather than have SRC and ERC.

A. There are various ways of cutting the cake. I do not think that that matters so much in terms of setting the overall priorities as getting a coherent body that can make coherent judgments across the spectrum of science. That is what we have to aim for.

Chairman

545. Given that the best guidance system of all is intelligent and well-educated people doing work at grass roots level, and given a statement of what might be called national priorities for the science base, one does not cut the cake from the top but one responds to the applications coming up from the bottom from people who are well aware of what the priorities are but are also excellent people. It is no good having a top down prioritisation if there are no good people to guide you on the priorities. All you will do is bring the system into disrepute.

A. Yes. You can get the considered wisdom of a group of senior people only if they are fed with robust information, and information that represents the totality of the community. That is what one sees in Japan. There the grass roots signals are very strong. We have to strengthen that. One result of what you are suggesting, my Lord Chairman, is that you have to increase the seedcorn part of the dual support system. I and many of my colleagues in industry will support that, but there still has to be some selectivity. In the end, I do not see that science and engineering will suffer too much. What will happen is that what is called science and what is called engineering will vary at the interface. One may get distortions of that kind, but in the end one has to work with people in the base. If they are good engineers and scientists you will get good work. If there are more of one or the other for a period there will be a distortion.

546. Two questions in particular concern us. First, there is a need for some body to take an overview of the whole scientific system in this country. Secondly, there is a need to see whether we are getting value out of our European connections and whether we are penalising ourselves by the process of attribution, because we tend to be rather successful in Framework programmes, for example.

A. On the question of working with Europe I have to say two things. We are not sure whether we lose money through attribution. It is a closed book. I think that even the DTI will accept that. The Treasury is not sufficiently transparent for us to know which way the losses go. It is certainly true that the French come in with the feeling that they are not going to be penalised. That makes a great difference in terms of their attitude. I would say that when British scientists and technologists get involved in committees in Brussels they carry considerable weight and have great influence over the decisions that are made. I have no worry at all about our being able to hold our own in the European scene. There is rather a stand off between the research councils and DG XII, the R&D Directorate. I think that if we are to have a Framework programme the research councils of all countries ought to be part of the inner council that agrees what the policy is to be. We cannot complain if we stay out, by saying, "Well, they are distorting our programme". It ought to be our programme that they are implementing for us. I think that the system will work very well.

547. With an office in Brussels?

A. Yes. Some of the research councils have people in Brussels. I would like to make it much more a policy issue rather than a question of dealing with the nuts and bolts of the Framework programme. I think that the research councils in Europe could make a very fine fist of it. I want to return to the other glorious job that has been described, that is, a person to oversee the whole thing. I would not mind if that person was not a scientist or engineer. I think this is a valuable thing; it would be almost an ombudsman system. It would be the most marvellous job in this country.

548. We have tried to get from one or two of our witnesses how they would prioritise their science. You have had the job potentially of prioritising R&D expenditure in Unilever which is a tremendous international company. You are adviser to a very big Japanese company. Are there any lessons which we can draw from that experience for this country?

A. Yes. When one has a big multinational company with several business areas—after all, that is what a country is in a way, except that it is then "national", but it still has several interests or business areas—the most effective science and technology activity is when one allows the businesses to choose about 80 per cent of the activity. The R&D function is to manage that activity for them and provide the scientists. The R&D job is to provide the technology, to do the transfer, and the marketing people should decide what are the key areas that they wish to address. One then needs 20 per cent—the equivalent of the national science base—to do the broad-ranging research. Some of that money is spent with the universities. I would never have spent money with a university without having an activity inside the company. Sometimes that is what goes wrong when we try to stoke up R&D through LINK. I would like

[Chairman *contd.*]

to see LINK inside companies, not outside them. That is the only way to ensure that it will be taken seriously. That is the simple lesson. At the moment, one of my jobs in Kobe Steel is to persuade R&D to let the business have more direction, not management, over the research base and move to a smaller science base and have more business-orientated research.

Lord Butterworth

549. You expressed the view that you thought there could be improvements in the contribution of the DTI. Many of us have had evidence of that in other fields and on other committees. What kind of contribution could the DTI successfully make, and how would you set about it?

A. First, one would have to stabilise the DTI. It has had an unfortunate decade. There have been movements in different directions. I think that it has lost many of its good people because of that. One has to restore it to a higher level of competence than it now has to address these questions. One then has to say that what the DTI will do is what MITI does; it will conduct an orchestra. The players will be the companies in this country. It will not really tell the companies what to do; it will try to talk to them and work out with them what are the main priorities on the industrial side and formulate them.

550. There was once a chap in DTI whose name was Colman.

A. Ron Colman.

551. Did he not begin to pioneer a bit of a new attitude in the DTI, particularly in welding the academics and industrialists together especially in biotechnology?

A. Yes. Unilever had a very good relationship with Ron Colman, partly because he did not tell us what to do but found out what we wanted to do.

552. And then told the academics what to do?

A. No. He found out where the competences were and acted as broker—no more than that. People say that the DTI spends too much money. They do not need a lot of money to do this kind of activity and act as brokers. If industry really wants it, it will pay for it. There are pump-priming activities for which money is needed, but many of the schemes should be no more than that for industry.

Chairman

553. In a previous response you referred to a small science base. I was not sure whether you were commending that as far as the United Kingdom was concerned.

A. No. My mind strayed back to the question of the increased number of students without an increase in funding. I think that at the end of the day if we do not get more money we will seriously have to consider keeping the quality of the science base rather than the quantity. If I am put up against a wall and threatened with shooting I will settle for the higher quality. Although we are in a tight corner in research, at the moment we are probably trying to support too much with the money available. I would first argue for more money, but if that was not possible I would shrink the base.

554. That makes the problem of choosing priorities even more acute?

A. Absolutely. I think this Sub-Committee is absolutely right in taking evidence before the announcement of the White Paper. I think it will be a fund of valuable information for whoever has to implement the findings of the White Paper.

Lord Porter of Luddenham

555. Can I put you up against a wall? Purely personally, based on your experience and looking retrospectively at what you did as chairman of the SERC, do you feel that the SERC roughly got right or hopelessly wrong the balance between big science and little science, that is, the proportion that went to chemistry and main stream physics and biology, compared with astronomy and nuclear physics? If you were starting today would you go for the same ratio, or is it entirely wrong?

A. In the time that you and I were members of the council I think that we set off along the right path. We tried to stabilise nuclear physics, astronomy and space at a certain level. I persuaded the space people to let the astronomers have their head because at that time they were by far the better community of scientists. That bit we got right. I think that I was right to try to grow engineering because when I arrived only 8 per cent was actually spent on it. When I left it was 22 per cent. Arguably, the expansion was too fast so there was some low quality. What they did not do afterwards was have a shake-out on engineering and go for quality. They went on trying to do things that industry should have done itself. In terms of science, I believe that we got too involved in big systems that we should not have gone into. For example, we should not have had alone a second source in neutron-scattering. We should have been more international with our big and small science sources. As a result the scientists began to eat each other on the different committees. It was a dreadful thing to behold in the past 10 years. It was sad to have chemistry committee meeting separately as inorganic, organic and physical chemistry panels. This is not what chemistry is about. They were there to promote science, not fight each other. That is what has gone wrong. It is due partly to the pressures of funding, but a bit of leadership could have helped with that.

Chairman

556. Sir Geoffrey, we very warmly thank you for sharing with us your unique experience.

A. Thank you.

WEDNESDAY 16 JUNE 1993

Present:

Butterworth, L.
Chorley, L.
Dainton, L.
Dean of Beswick, L.
Flowers, L. (Chairman)
Porter of Luddenham, L.
Selborne, E.
Tombs, L.

Examination of witnesses

Dr Geoffrey Robinson, Chief Adviser on Science and Technology, Mr Richard King, Head of Branch One, Innovation Policy Division and Dr Alistair Keddie, Head of Innovation Unit, Department of Trade and Industry were called in and examined.

Chairman

557. I wonder whether you would like to say a word about yourself and your role within the Department and make any other introductory remarks you like.

(*Dr Robinson*) I am only a civil servant of a year's standing. I joined the Department actually about six weeks after Mr Heseltine assumed responsibility last April and just a week before the White Paper was announced, so my timing of arrival was interesting. Prior to that I spent all my working life with IBM, most recently as their Director of Research and Development here in the United Kingdom. Throughout that time I have been involved in many interactions both with the Science Base and with Government. So when the time and the opportunity came to consider this post, I felt that perhaps this was something where I would like to make a contribution, from my industrial background, to what I think is a very important subject. The timing has also been interesting in that a number of events have gone on over the past year, which will affect some of the answers that we give to your questions this afternoon. Obviously most important of all, the White Paper just recently released two or three weeks ago, has coloured a lot of our thinking over the past year. Richard King, who has responsibility within the DTI for the explicit policy work that we do, was heavily involved with OST on the White Paper, as also Dr Alistair Keddie, who heads the Innovation Unit within DTI and who is responsible for its output, in the consultations that we had about Faradays and we discussed with you on the last occasion. So the last year has seen a lot of work in support of the White Paper but also, as Mr Heseltine indicated when he was here, we spent a lot of time looking at DTI's priorities, our own processes, our own programmes, including a new policy prioritisation process that we are working on within the Department. We might allude to that from time to time during the session. Then most recently of all I suppose, or most relevant of all, we are now starting the process within DTI of actually changing what we are actually doing in the light of the White Paper. We will give you some indication of what we are now doing and what we will be doing in the future. That I hope will be of interest to you, so our answers would both span historic and future activities. You asked what my own role within the Department is—I suppose I occupy two roles which have some distinct features about them. The first, as my title suggests, is I have a responsibility to advise all DTI Ministers on any aspect of Science and Technology, Research or Development, in any of the Department's programmes. But then more specifically, I have a direct line management responsibility for one of the Commands within the Department. That includes the Innovation Policy Division, the Technology Programmes and Services Division that we now have, the Department's responsibility for the British National Space Centre coordinating policy, and our Environment Division. I also act as the Executive contact point for the Patent Office Executive Agency. So there is both an advisory role and then a direct line management responsibility.

558. May I start by saying that the White Paper, in my personal view at any rate, is pretty good as far as a White Paper can go? Of course we now need to see the machinery that is going to give effect to it and all that. But it is clear that the White Paper will succeed in its aims, which are admirable aims, only if the whole of Government—indeed the whole of the nation—supports it and cooperates with OST and gets some sense of national purpose generated in this area. The only evidence we have about that at this moment, is the chapter on MOD research, which appears to have been written by another hand, belonging to somebody who has a totally different set of objectives. I do not expect you to answer for MOD. I just make that flat, somewhat rude statement, but DTI has been associated in—I do not know about the public mind, but in the university mind at any rate—with rather short term attitudes towards wealth creation and on the whole that does not greatly assist basic research. I wondered whether the new commitment in the White Paper, is one that is going to lead DTI to change its attitude towards the Science Base as a somewhat longer term objective?

(*Dr Robinson*) I really cannot answer for OST and MOD in that particular context. What I would just like to say in general, with regard to other Government Departments, is that we do not feel that there is necessarily any fundamental ambiguity with the pursuit of the research and development in support of individual Department's policy responsibilities, with the recognition of the important impact that that work may have on wealth creation possibilities. We do not see that there is any fundamental conflict of interests. Part of the dialogue that we have indicated in our own statement that we wish to take up with other Government

[Chairman *contd.*]

Departments, is the extent to which policy objectives can be more supportive of wealth creation objectives, as opposed to hypothetically, as it were. On the DTI, I think my own perception in respect of your remarks is very much that, to a large extent, DTI had not been clear what its objectives were with respect to the Science Base and with respect to research and development. To some extent, perhaps, we had allowed other people to set the agenda for what DTI's role was. Part of our own policy reviews, both in our own context and in White Paper discussions has been to clarify what it is we are actually trying to do and, against that backcloth, what should our role be? The short term-ism question that you raise is very fundamental in a number of different respects; first if I may say, I do not see any fundamental ambiguity with industry's interests in wealth creation and the concept of basic research. I think we might have a separate discussion about basic research in a mission orientated sense and curiosity driven research and so on, but in the sense of basic research *per se* I do not see that fundamental ambiguity. Indeed when I talk to people in Japan, they do not understand that concept. They understand research from the market place orientation and may have to go further back into more and more basic research, but they still think of it in a potential market application sense, so we do not see the ambiguity. Indeed on a slightly personal note, one of the last things I did before I joined the Department, was to receive the Queen's Award for Technology on behalf of IBM, jointly with Oxford University, for the work we had been doing over a ten year period which, when we started was extremely basic, but actually turned into something more substantial. In terms of DTI's role with respect to basic research, I think we would see in large measure our thought process being represented in what the White Paper says. We want to improve the dialogue, through research foresight or industrial representation in the Research Council's systems, at very early stages in people's thinking about research opportunities—not necessarily to bias them in any way and certainly not necessarily to turn them into short term activities. Improving such dialogue is one of the ways in which supporting basic research in university systems can lead to wealth creation potential without any damage being done *en route*. In terms of looking at what DTI itself funds, which might be part of your question, I think then we have to address two aspects: one is the recognition that, in the end the acid test of the value of research work is going to be in the market place. Part of our rethink has been to recognise that, in common with received wisdom, the United Kingdom skill in basic research is outstanding. I am not qualified to judge, but I certainly accept the verdict that is given. We have demonstrated on a number of occasions with a number of reports and so on that our weakness, if any, is how to turn that into market place success. So the focus of our rethink has been how can we actually improve the level of dialogue early in the research process, so that research work—even when it is basic research—is more likely to be in areas where wealth creation potential might be foreseen? Secondly, on a much broader remit, to create the sort of environment in the United Kingdom, where the dialogue between industry and academia is much better than it has been, including getting the City more involved in the debate. So that when research is at the stage of being exploitable, it is likely that people will be ready to exploit it; as opposed to what we perceive at the moment, which is that work often falls off a cliff because there is nobody ready, with the knowledge and expertise, to exploit it. So we do not see that fundamental conflict. We do see a role for encouraging relationships between industry and the Science Base in the research formulation process; we also see a role for encouraging the exploitation, dissemination, amplification and access to technologies where we, DTI, should put our focus. In the end, at the very explicit point where one is trying to turn research results into commercially successful products, then we do believe that industry and the market place has to be the best judge of that opportunity.

559. The Science Base is defined for the purposes of our enquiry -

(*Dr Robinson*) Yes, it is.

560.—as science and engineering research conducted in universities and Research Council laboratories, no matter who pays for it and it is therefore reasonable of me, I think, to ask you at the outset what you feel the relationship of DTI ought to be—let us talk of the future—towards the universities on the one hand and Research Councils on the other.

(*Dr Robinson*) I know there is a discussion about the role of Research Councils with respect to their own institutes and with respect to universities. That is not something where we, DTI, feel we have a lot to add to that particular point. Let me first of all start out with one of the pieces of work that we have been doing, just analysing our current relationships with the Research Council system. They are, of course, extremely extensive with SERC: fairly significant cross-representation on Committees, lots of interaction and a very heavy level of involvement there. To some extent the position that we have taken on our rethink is that we start off with the premise that we have potentially equal interests in all the Research Councils and their activities, because to a greater or lesser extent they are all doing work that has wealth creation and industrial interests, or potentially so. So as part of our rethink, we have established the principle—and in fact discussed with the Research Councils—that we would like to strike, what in the current jargon is known as a concordat between ourselves and each of the Research Councils, covering our mutual interests. I would on that point stress the importance of SERC. However sometimes we are looking in too close a focus on the more traditional sciences. But when one looks at the problems industry is facing, many of the current challenges of modern industry are to do with people; they are to do with economic considerations, they are to do with change. Perhaps we ought not to overlook that in our look at the whole Research Council system. So we start off with a relatively clean sheet of paper. We do feel that the many interactions we have with SERC have taught us a lot of good things that we can do and some areas we have to work on. The splitting up of SERC into two bodies, I think, is a

[Chairman *contd.*]

very good chance to think through some things afresh. Part of the reason that we felt that we had to look very hard at the relationship with SERC is that, to some extent, we have never been totally clear on what our respective roles were. We had a very heavy interaction over things like the information technology programmes, where we are both funding similar research. But I think part of what the White Paper lays out for us is the chance for us to have a more complementary and even broader relationship than we have had in the past. If I can give an example (and let me talk about the areas where we have worked with SERC) where we have a lot of experience. As I say, we have very heavy interaction over things like our joint information technology programme. We have not paid an awful lot of attention, however, in those discussions, to other areas where we have some mutual interest, but these just do not happen to coincide in terms of specific programmes. For example, European programmes at one extreme, or at the other extreme, the whole technology transfer, diffusion and access process. So what we need to do in rethinking our relationship, is not just to talk about the technology development piece or the research piece, which everybody is familiar with, but to talk about the total end-to-end process that we need to worry about and what our role is in that process and what is the Research Councils' role. I think to some extent we have both been treading too much in the same patch in a relatively narrow area of what is a very big subject. I would like to make one other point about university relationships and Research Councils, if I may and that is that too many of our discussions about the links between academia and industry tend to be about specific research subjects, the sort of things that are bread and butter to the Research Councils. I think we also need to recognise the importance of universities as institutions and increasingly institutions that recognise the need to worry about their own future as an institution, rather than just a collection of individual departments. Complementary to what we are trying to do with the relationships with the Research Councils, we are focused on the question of how can we improve the relationship between industry and universities in general. This often means getting down to local areas of interest and local areas of interaction. To some extent, for example, the Teaching Company Scheme is a pioneer of that thought process, where a lot of what is going on is to the benefit of local industry and universities working with each other. So we feel we have this dual interest: on the one hand the technical issues that Research Councils worry about, but broadening it slightly into other areas. Then at the other end, the relationships between industry and universities as institutions, most probably driven through the initiative that Mr Heseltine announced on "one-stop shops" for local access to business information, technology advice and so on. So part of what we will be doing—in fact, we just announced it this morning as part of an internal reorganisation is the setting up of one of the branches within DTI, to deal with the provision of technology access within the "one-stop shops". Part of their remit will be how we can improve the relationships between local industry and its local higher education institutions? If we can approach the overall relationships between industry and academia from both the local broad interests and through the national research interests, we actually feel we can begin to tackle this problem.

561. That is quite an extraordinary statement to come out of the DTI, if I may say so and thank you very much.

(*Dr Robinson*) I hope I have been answering your questions!

562. Do you see DTI as an essential part of the machinery for setting priorities for the Science Base, or are you just on the sidelines as far as that is concerned?

(*Dr Robinson*) There is still a lot of detailed machinery to be put into place following the White Paper. I will certainly share with you what the DTI view would be; we shall have to see how it all settles down finally. I think there are two aspects that we need to recognise and try and address at the same time. The first is that we really do want to encourage the direct interaction between the Science Base and industry, between Research Councils and industry. The technology foresight exercise, and the proposal to have more industrial members on Research Councils and so on should do that. But I think we also need to recognise that, by definition, the formal interaction of individual companies through the Research Councils, the technology foresight exercise and so on, will be relatively limited just for sheer logistic reasons. So part of what we are discussing with OST is the extent to which direct industrial—in terms of individual company—representation in those exercises is appropriate and to what extent DTI represents a broader community of industrial opinion. In principle I do not see any conflict in that. In that sense, I should be very explicit; we feel our role is not that we ourselves, DTI, have a view of priorities, but that we are trying to ensure that the priorities that industry would perceive are well represented, which is why we are more interested in the mechanics of the process than we are in any particular DTI received wisdom.

Lord Porter of Luddenham

563. On the basis of what you have just been saying, what would be your attitude for example to the new Research Council for Astronomy and Particle Physics, which is admitted by everybody not to be a wealth creating Council? How would you, the DTI and indeed industry when you are talking to them, view that, do you think? Or would have nothing to do with it perhaps?

(*Dr Robinson*) Let me answer both in the general and in the specific. First, I tried to indicate in my previous answer that we do not feel it is DTI itself that has priorities, but we are trying to represent the priorities of others. The second point is that we do—contrary to some comments that we hear about DTI—recognise there are various other legitimate priorities for the Science Base than wealth creation. Our concern is just to make sure there is a process into which the wealth creation priorities fit, in an appropriate manner. The model that we have used is to think in terms of the potential client communities for the output of research, if I can put it that way.

[Lord Porter of Luddenham *contd.*]

Sometimes this is industry but sometimes it is other 'quality of life' bodies, or other bodies, perhaps like the Royal Society or other learned societies, that really have a very strong interest in the quality of the research. Whatever process is put in place, I think any priority system needs to reflect those different objectives that people would have and needs to be brought together in that way. In terms of the Particle Physics and Astronomy Research Council, I think there are aspects of that which are desperately important; I do not subscribe to the view that they are devoid from any relevance to, or interest in, the contribution to wealth creation. I do not subscribe to that view. It is not as obvious perhaps as in some of the other Research Councils.

564. The OST White Paper actually essentially says all the other Councils are basic, strategic and applied, but that Council is not; it is just basic?

(*Dr Robinson*) If I may again, there is no fundamental conflict between the description of the research and the research motive which, as you say, is rightly spelt out in the White Paper, and recognising that they still contribute in a rather broader sense to wealth creation, in two very specific ways—as I am sure you want a very specific answer. The first, of course, is the whole question of trained manpower, which we should never exclude from our whole discussion. I do worry that we do not concentrate enough on that. As somebody whose own PhD was in quantum mechanics, I do feel quite strongly about that point—from Nottingham I am proud to say your Lordship, while you were Vice Chancellor there. You will not remember, but I remember you.

Chairman

565. Flattery will get you nowhere!

(*Dr Robinson*) I realise that, but we must not forget that point and, very seriously, I do not think we concentrate enough on it. Secondly, one of the things about astronomy and particle physics—or space, for example in an area where we, DTI, have an involvement—is that they use very expensive facilities and they require to do that research, almost by definition, "leading edge" technological facilities. I alluded earlier on to this point, when I said that I did not see any fundamental conflict between pursuance of policy objectives, other than wealth creation, with the wealth creation objective. We could perhaps, and certainly what we feel in DTI we are trying to do with the space programme, have a very strong interest in, the question "How will the development of the facilities themselves bring forward the engineering infrastructure of the United Kingdom"? It is not the same wealth creation interest as the other Research Councils, I do agree, but I do not think we should ignore these facts.

Lord Porter of Luddenham

566. The conflict is between the proportions is it not?

(*Dr Robinson*) Yes.

567. The conflict, in the end everyone would agree, would come between two Councils, one of which is doing non-productive research as far as wealth creation is concerned and as far as you are concerned, I suppose what I am asking you is would you usually shout for wealth creation?

(*Dr Robinson*) I think we would have to represent that view by definition. We feel that would have to be our view.

568. You would recognise even if there is—like particle physics—on the whole very little wealth creation, there is a place that has to be considered here for basic research?

(*Dr Robinson*) I think in terms of the priority process—and this of course is a significant part of the remit of the new Director General of the Research Councils to advise Ministers on this—there are four major priority streams that need to come together. The first, we would argue, is the wealth creation contribution and we would feel we would have to represent that from DTI, but not to the exclusion of everything else. The second are the quality of life aspects: environment, health and so on. The third is the quality of science aspect and we must remember, if I may take the opportunity here, to recognise that none of us have an interest in funding in second rate science. This is all about producing excellent science as well as its other roles, so that interest has to be properly represented. The fourth is the trained manpower output which has to be properly represented. Perhaps it is a hypothetical point, I do not know your Lordship, but if you faced me with: "You have to take a decision between prioritising *this* particular area of research, which seems to contribute more directly towards wealth creation and actually does very little for producing trained manpower, with *this* particular piece of research which appears not to do an awful lot of direct wealth creation, but actually is very good at producing trained manpower for industry's needs", I would say that was a fairly tough question you gave me to settle on. The prioritisation process has to reflect those different interests. I would say DTI would have to represent wealth creation in all these aspects.

Lord Tombs

569. I would like to come on to the perhaps very special role of DTI in setting priorities. DTI is the Department of Trade and Industry and obviously we should look at it from that standpoint. I think it would be common ground, we have had a fairly incoherent policy for the past decade or so. This has come about for a variety of reasons, mostly discontinuances. During that period they have largely been reactive and I would like to see some proactive schemes. I would like to know whether there are any proactive schemes in the new DTI strategy you described as forming. We used to have things like demonstrator programmes and prototypes, which we do not have any more and which are an essential link in the transfer from design quality research, to the market place. DTI ought to be looking at the weight of imported goods and our deficiencies and how they can be remedied by a variety of mechanisms and I am not conscious of that being done. Given the overriding objective, or the very powerful objective in the White Paper towards

[Lord Tombs *contd.*]

wealth creation and the special role of the DTI in that process, I wonder if Dr Robinson can say something encouraging to me about the proactive approach by the Department in these areas?

(*Dr Robinson*) My colleagues may like to answer part of that from their perspectives, about the approach we have been trying to adopt. But I think most people on the inside would regard it as a fairly proactive view of life that we are now trying to consider. Let me give some instances, because I realise that general statements "butter no parsnips". Firstly, the recognition, if I can go back to one of my earlier answers, that it was actually hard to say what DTI's approach to science and technology priorities had been. That was partly the reason that Mr Heseltine asked me to review the whole panoply of what we do. We have done an end to end rethink about the whole process. If I can give a couple of specifics, which I believe are proactive, both of which as it happens we announced as part of our reorganisation this morning. It is common jargon that 95 per cent of science and technology work that goes on in the world, goes on outside Britain. One of my earlier observations was, in that case, why do we have such an enormous preponderance of our own resources looking at what is going on inside Britain? Why do we not have more of it actually looking at what is going on outside? We indicated that in the White Paper and in our own announcement, and formally set up the organisation this week, to establish what we call an "overseas technology brokerage service". It will be headed by Dr Richard Hinder, who has recently come back from being the United Kingdom Science and Technology Counsellor in Tokyo; a very energetic person I may add. Our objective is to establish a number of people overseas, funded by the DTI, doing what other countries do so well—keeping up to date with technology developments overseas and how we can benefit from them. I would hope that is proactive. At the same time, we recognise there is no great value in just having yet more unread reports about 'this new piece of technology in Japan', or 'this piece of technology in the USA'. We need to have a delivery system, by which this can be of value to people. We would hope that some part of that will feed through into our own involvement, but actually we need to get that information down to the grass roots of United Kingdom industry. The combination of Mr Heseltine's sectoral divisions for United Kingdom industry and the "one-stop shops" actually give us a delivery mechanism for how we can transfer that information into industry. Which brings me on to the second proactive piece, which I did allude to early on. We have set up a branch for "technology advice and support" in the one stop shops. We have announced that we will have a programme of technology counsellors who need to be part of the business advice support process. But more importantly we are looking—based on some conversations which Lord Tombs and I have had on this demonstrator point—at what it is that we can do to improve the technology transfer and best practice mechanisms that we could spread throughout industry? We have a "best practice" programme called "Managing into the 90s". Again part of our proactive approach is we need to structure the whole gamut of things we do to help industry into some sort of common framework that they can relate to. That includes technology transfer, demonstration, expertise, advice and support. What we do not know at this stage is whether that particular type of programme will translate into strengthening links with local industry or translate into technology demonstration programmes in the way you and I have talked about. But we are addressing that subject proactively. The third point, if I may, relates to Doctor Keddie, Head of the Innovation Unit, who has been full-time involved in our work on the White Paper. This means that perhaps he has not been able to give us as much time as we would have wanted into leading the Innovation Unit. I think those who have been aware of the Innovation Unit's activities, regard it as one of DTI's significant strong points. We have announced we are going to expand the role of the Innovation Unit. It currently has six full-time industrial secondees working on a largely central but slightly regional basis. We want to increase the size of that significantly to maybe 20 or 30 and have people not only here in London, but actually located outside the city, to try to strengthen the whole climate for support for R&D. A significant part of that is relationships with the "City" part of what Dr Keddies team have been doing is actually starting to build on this and bring the City more into the dialogue. I think the Innovation Unit has done well, although it was set up before my time. It is a very good example of the proactive DTI approach. The problem, if I may put it this way, is that not a lot of what I have talked about involves DTI funding scientific research. It is easy to characterise a lot of what I talk about—looking at what is going on overseas, making it available to the United Kingdom companies, stimulating the sort of activity that the Innovation Unit does, as rather 'wimpish' compared with doing yet more research. But actually I think the problem we have in the United Kingdom is we do not have the total infrastructure in place and that is what we are looking towards. Are we doing enough? Almost certainly not. Are we doing it fast enough? Certainly not. But I think we are tackling the right problems and we are tackling them in a rather proactive way.

570. For me, most of that answer deals with enabling means, not proactive means. There is a much more aggressive role within the DTI which connects with the Science Base, which has to do with the weaknesses of the manufacturing sector and if you like to use the phrase, the wealth creation sector. I would like to see the DTI taking more of a leadership role. That does not mean picking winners and backing losers and so on; it means taking a leadership role, identifying areas where there is a need for more organised research and not concentrating as practice seems to be, on systems and a system mechanism. To me that is valuable, but not enough. There needs to be, it seems to me, a more proactive approach: get out there and find out what the problems are and then try to solve that problem within the DTI, than has been the case in the last several decades.

(*Dr Robinson*) I worry that my answer may brand me as a civil servant!

[Lord Tombs *contd.*]

571. I think you are going that way!

(*Dr Robinson*) You are of course raising the whole question of broader DTI industrial policies and strategies and I think that is probably a question for somebody other than me.

Lord Dean of Beswick

572. You used the term "privatisation". What were you talking about?

(*Dr Robinson*) With all due respect, I have no knowledge of coming close to that.

Chairman] I think you said "prioritisation".

573. I misheard you, I am sorry. I would like your opinion on what Lord Tombs raised as to who would make the decision as to how you slide the balance, whether you go down the commercial route, or where you start to broaden the actual operation out to include more people?

(*Dr Robinson*) It is a very difficult question and I will do my best to answer it. Firstly, no one likes to be put in the position of saying: "Shall we do more research or shall we try and broaden its applicability?" The answer is we would like to do both, but the very specific difficulty we feel—

574. You are going to be faced with priorities?

(*Dr Robinson*) Yes, indeed. I think my own personal judgment, as well as the judgment of the whole Department, is very much that the significant weakness that we see at the moment is the exploitation and dissemination of what research has already been done. Therefore before putting more money into research, at least from the DTI point of view, we would really like—to pick up Lord Tomb's phrase—to feel that we are comfortable with the exploitation, dissemination enabling system into which it was going. The second half of your question relates back to the prioritisation process in general and that is this question of picking winners in technology from our point of view. I draw the distinction of picking winners in technology from picking winners as individual companies. If I can address it in terms of the Technology Foresight exercise I think it is not fundamentally difficult to recognise that certain technology areas are more likely to contribute to wealth creation than others. There is always the exception and I digress very slightly, I would not want any of my words to lead to the impression that we do not feel there is room for the wild idea, out on the side as it were. In fact I worry that that approach is not recognised enough in what we do. To come back, the idea that some areas of technological and scientific activity are more likely than others to contribute towards wealth creation, is not that desperately difficult to get people to accept, but it is more difficult than that and more complicated than that. If I may, at the risk of appearing slightly to prejudge things, it is relatively easy to say that biotechnology and materials technology and so on are more important and likely to contribute to wealth creation than perhaps some other things, but that does not say an awful lot in itself. If we are not careful, it just gives a lot of people a convenient umbrella under which to say: "Actually what I am doing is biotechnology, or what I am doing is materials technology" and nothing fundamental changes. The most important thing in this prioritisation process, I think, is to some extent the process itself, where you are getting industry involved—hopefully this is what is going to happen—in the form of real companies being involved. So you are creating the dialogue to start with between industry and the Science Base. I think any time that we say: "We in the Science Base think this science or technology area is important, but we cannot get anybody from industry to recognise that and say that", then I think that should be the first warning bell that should ring. One of my phrases is: "Let us never forget there is no such thing as industry out there. All there are is lots of individual companies. So I sometimes say to my people: "If I cannot pick up the telephone and call the Chief Executive of the company that you are about to name, then you do not actually know what you are talking about". Therefore in this prioritisation process, just one indication is that real companies are there, real companies are prepared to participate in the debate and that in itself, as far as I am concerned, takes you a long way forward. It still leaves the very difficult question of prioritising between technologies, biotechnology or materials for example, where real industrial involvement is present. I would hate to give a general answer to that question. I do recognise that it has to be faced. If I may say, part of what we have been doing in DTI over the past year is recognising that we are taking some very difficult prioritisation decisions, some of which you may have heard about. So the important point from my point of view is there is a prioritisation process and it will involve biasing the funding of the system towards things that are more likely to contribute to quality of life, or more likely to contribute towards wealth creation and one of the best definitions of "more likely" is real companies are involved there, possibly even putting money into it.

Chairman

575. Does the winding up of the Advanced Technology Programmes now mean that you now consider them to be in areas of low priority?

(*Dr Robinson*) No, indeed not and I voluntarily gave you the lead to ask that question, by saying about the difficult decisions we had taken. I think the issue that we face is really two fold: One is, again very deliberately, we need to recognise the end-to-end spectrum in which we are involved and the extent to which DTI makes a fundamental difference by what it is doing in that area. In that sense, the contribution we make with our Advance Technology Programmes, was of the order of £20 million or £25 million a year. So part of our very conscious decision was very much to recognise that we are not making a fundamental difference with that level of investment within the scope of our total priorities. So in that sense, it is not a question of whether we think they are high or low priority technological areas, it is really a question of, is DTI making a fundamental difference in those areas to the research, development and market place exploitation process as a whole. Within our prioritisation process—and I have to admit these things are not easy—we actually said that is not

[Chairman *contd.*]

where DTI is making the most difference using the money we have to spend. It actually is not a vote of no confidence in technology.

576. Within the sort of view that you have just presented the priorities, how would you justify the closure of the Warren Spring Laboratory?

(*Dr Robinson*) I do not think I would begin to justify it in terms of those priorities at all. I think that is a separate question and if I may, the decision about Warren Spring has been a decision to consolidate the work of the Warren Spring Laboratory in the National Environment and Technology Centre. It is a question of reducing funding of any particular piece of work. It is a question of improving the efficiency with which the work is carried out.

577. It is not the view that work on pollution and environment generally is not wealth creating and therefore redundant?

(*Dr Robinson*) Absolutely not. It is no part whatsoever of the process I have just talked about. It is a decision based on how can the Government as a whole get best value for money in exercising those programmes?

578. I think you might have a look at your PR, if I might say so.

(*Dr Robinson*) I take your Lordship's advice.

Lord Dainton

579. You referred twice to trained manpower. I would like to know what you see your role there is and how that effects priorities in basic research? That is the first question. The second question relates to the fact that you said 95 per cent of research is done elsewhere, but also we lose such a lot of our own research for wealth to be created elsewhere. In DTI's view, how do those two facts relate to priorities in basic research?

(*Dr Robinson*) I will try and answer quickly. They are both very big subjects. Certainly the most enjoyable meeting I have had on the White Paper was in an Oxford Quadrangle, last Thursday evening.

580. Before or after dinner?

(*Dr Robinson*) Before and after dinner! As one of the guests of honour at the dinner, I was late, because I was having a very interesting meeting with post-graduate students and I happen to have a son who graduated yesterday and is going to be a post-graduate student, a physicist, so I have some interest in it. I think if the White Paper is about anything, it is about tomorrow's generation of scientists. I found myself spending a long time, actually going into the night, with this group of people. Essentially it started with: "What do you think you are being trained for?" I think if DTI has a role to play in this area, it is to make sure that the view of industry as a consumer of trained manpower is well represented. I think in looking at the production of trained manpower through the research process, one has to recognise that of course some part of that training is to produce the trained academic scientists of tomorrow. Any system has to produce its own future, but that can only be a small part of the trained output in the system. The second piece is the training of research scientists for industry. I think part of what we have to recognise is that the science—if I can use that phrase—that goes on in industry, sometimes is like academic research, but more often it is not. We therefore need to understand if we want industry to benefit from the training experience that post-graduate research brings, then the industrial perspective of research and development needs to be borne in mind. My own experience was my own "training" for my PhD, in the end had nothing to do with what I was going to do afterwards. Then the third is to recognise it may not be bad news for our trained manpower to go to the City, to go to the law; it may be part of our responsibility in the scientific community to keep tabs on them when they have gone that way, so they can be part of this bigger community that we are trying to create. The second part of the question—the overseas piece—I think I would have to remind your Lordships that I spent 23 years working for a company whose ultimate parent was American, so I have to declare that fact. It never troubled my conscience what I was doing. The fact that I was putting money into British universities did not trouble my British conscience. The fact that perhaps the Winchester Scientific Centre I helped to set up, may be an archetypal Faraday Centre that had British academics walking in and out, did not trouble my conscience. I did not see any fundamental conflict, because I actually think that I contributed a lot to the United Kingdom. The more we can internationalise ourselves, perhaps the better we would be. Having said that, I know it is an area of some concern and one of the things that I have personally been doing is actually looking further at the pattern of the Japanese and other Asian countries investments in R&D facilities within the United Kingdom, like what they are doing in universities like Guildford and Cambridge and so on; in some of their commercial operations that they have here. I have also talking to R&D directors in Japan and asked, "Why do you invest in the United Kingdom?" I think it is important that we recognise that an international dimension is here. I happen to think it is good, but we have to manage it intelligently. We have to build those relationships. We have to make sure that the United Kingdom benefits as a whole. So our interest is in supporting inward investment, supporting inward investment of R&D, making sure it is all part of a pattern of the greater contribution to the United Kingdom as a whole. I do not see any fundamental conflict, but I do agree it is something we need to understand more.

581. I think the difficulty of course is that benefit does go overseas. One could not deny that. One only has to look at X-ray and magnetic resonance and CT scanning to see that. It is a classic example. One wants to know really whether there is any benefit that comes to this country in any sense and how one could translate that back into what the universities do when they are training our people. I am with you up to a point, as somebody whose four year engineering undergraduate course, you will be well aware, has taken off. But at the post-graduate level I am a bit worried, because the White Paper says and we know there is going to be no more money, so an extra year automatically means three quarters of the output.

[Lord Dainton *contd.*]

Have we got enough? Have we got too few? Are they in the right subjects? What is DTI's view?

(*Dr Robinson*) The DTI contributed to the study on the future of the PhD that the ABRC set up. DTI's view in that sense is very much that the relevance-to-industry aspects of a PhD need to be strengthened. We have recommended that explicitly part of the PhD process should include some involvement with industry. I should perhaps remind your Lordships that DTI took the lead with SERC on setting up post-graduate training partnerships, which is very much around this theme and the equation all hangs together. I think if we can—through people, and through students is a terrific way of doing it—create links between academia and industry, while the research is actually going on. I am a great fan of the CASE scheme, because it creates a bond between industry and academia with somebody at the centre of that contract who has a real interest in its output being successful. If we can create those stronger links between industry based here in the United Kingdom, never mind what ultimate parent they may have, then we are more likely to get the work exploited here in the United Kingdom. If we do not have the links here in the United Kingdom, then one cannot be critical of United Kingdom universities or academic people looking for somebody who will exploit their work, wherever it might be. So the challenge is—whether the company is British, European, American, Japanese or whatever—if they are based here in the United Kingdom, we aim to encourage those links through DTI, make sure that the manpower training that is going on in the universities has an appropriate level of external awareness (even when it is something like the management of science and so on) as part of that process. If that means perhaps we have fewer PhDs but they have better training, that may not be a totally undesirable output.

Chairman

582. Dr Robinson, I wonder whether I might ask your colleagues whether there are any points they would have made.

(*Dr Keddie*) I do not think so. I think Doctor Robinson has covered the agenda pretty comprehensively, my Lord.

(*Mr King*) I would agree with that.

Chairman] Thank you, all three, very much for coming.

Examination of witness

PROFESSOR MICHAEL PECKHAM, Director of Research for the National Health Service, was called in and examined.

Chairman

583. I wonder whether you would like to take the opportunity at the beginning of explaining your role in the priority setting business for the Science Base and your relationship with the universities and with those who fund the Science Base, who are the Research Councils in your case and the big medical charities mostly. How do you fit into all that and what contribution can you make to their setting of priorities?

(*Professor Peckham*) Perhaps I could just set it briefly in context of the Department, because I think it relates quite naturally to the way in which we are assessing priorities. As you know, the remit that I had when I entered the Department was to establish a Department of Health R&D strategy which has three components: the Department's centrally commissioned programme directed at public health and social services research, a new programme for the National Health Service, including the setting in place of the infrastructure and method of approach and the third element which has to do with alliances between funding bodies and in one way or another all these actually impinge upon the question you have asked me. Just to take the National Health Service programme, we have developed a structured approach to priority setting for health, in which we have looked at the Health Service from six different overlapping perspectives and it was a pragmatic way of simply getting into a very complex problem, so we are looking at the Health Service from a disease perspective, starting with mental health, going on to cancer and cardiovascular disease. The second perspective relates to the R&D issues of NHS organisation, management and workforce. Thirdly, in relation to client groups, we are identifying priorities in children, elderly, disabled and so on. Then a fourth in relation to consumer issues, a fifth concerns health technologies and the sixth to do with research methodology. Each of these—and I just take one example, which was the mental health example—we have convened a multi-disciplinary group, an external group with an external independent chairman and we have asked this group to tell us what they think the priorities are for research and development in that field. When we convened the first group, it was a new experience; it had not been done previously; the method had to be invented. The input is multidisciplinary, going from basic scientists right through to the users of the Health Service. So for example, when we looked at disability, the range of expertise extended from the disabled right through to rehabilitation engineering and physics and physiology and psychology and a whole range of things that connect that. These priority setting exercises are backed up by information on the prevalence of the various conditions or components of the problem being looked at. This includes informatin on the costs, in so far as we know them, for the Health Service and society in general and any information about the feasibility of research. Then there is an extensive consultation exercise with Research Councils, professional organisations and charities and so on, as to what they see the priorities as being and finally the advisory group comes together and ranks a limited number of high priority issues. So it really is working

[Chairman *contd.*]

from the problem towards the research solution. And then on the basis of an analysis of problems and before commissioning research that we pass through two filters; one is, do we already have the information? Is it already existing, but we do not know that it exists, which raises the whole set of issues about handling research data? The second is, is there ongoing research of which we are unaware? This points to our very poor knowledge of what is going on. If the answer to those two things is no, then we commission the research. So we have developed a structured approach to priority setting in the Health Service and this has now been introduced into departmental priority setting for the centrally commissioned programme with a set of criteria not too dissimilar to those used for the NHS. In terms of my interaction with other priority setting bodies—let us take the Medical Research Council for example—the output of our priority setting exercises goes to the Medical Research Council in a formal way as part of the concordat, so that I present at the MRC Strategy Committee, the ranked priorities for the Health Service, and for the Department of Health. There is now, as a result of the new concordat introduced last year, an annual stock-taking meeting at which we look at the MRC's response to those priorities that have been given—and I can enlarge on that relationship if you like. In terms of my input into priority setting for the Medical Research Council, we have taken the view that we must have some familiarity with the total portfolio of the MRC including applied and basic research. So I attend both the science drive Strategy Committee, which is looking at the basic scientific strategy as well as the problem-orientated Strategy Committee, which is looking at more applied research and therefore have input into that process. In terms of the relationships with other Research Councils, we now have a—

584. With the big foundations?

A. With other Research Councils. I was going to say that we have established an agreement with the Economic and Social Research Council, because of the importance of health economics and of the social sciences to the R&D programme. To go on to the charities, we also pass the priorities that arise from this programme to the major charities, to the Wellcome Trust and to other charities and we have established a number of Research Liaison Committees to bring funding bodies together around the same table. So for example, in cardiovascular disease and stroke, we have convened a group that brings the British Heart Foundation, the Wellcome Trust, the Stroke Association, the Medical Research Council and the Department of Health together, to look at their respective strategies and look at the opportunities for at the very least complementary activities, even jointly supported activities. We have now extended that to respiratory disease, and biomedical technology. We plan to create a new health technology forum, which is again designed to bring funding bodies with a common interest together. That does not mean that we exert much influence on the priority setting mechanisms of charities, certainly not anything like the same formal input that we have to the MRC.

585. Do you have a similar sort of relationship with the relevant industries?

A. With industry?

586. Yes.

A. Yes, we have signalled our intention from the outset to develop such a relationship. Richard Sykes, now Chief Executive of Glaxo, has been a member of the NHS Central Research Development Committee. Now that he has stepped down we will replace him with another senior industrialist. We have developed a number of relationships; I will just give you some examples. When I first came to the Department, I was concerned with examples of internationally competitive basic research which had apparently very little prospect of industrial exploitation in the United Kingdom. One such example was vaccine research, where we have some very good basic immunology, but at that time in 1991, little prospect of vaccine production. As a result of a meeting to explore the issues, which was attended by Richard Sykes, the Board of Glaxo have agreed to fund a new Research Institute, and to provide core support for ten years. The Institute will function as an independent research hotel, housing basic science groups in immunology. We held a meeting, at which the Chief Scientific Adviser attended and the Medical Research Council and so on. There was enthusiasm for the Glaxo proposal which is now being taken forward. That is one example of working with industry, but to formalise our relationship, we are poised to establish an NHS Industry Research Advisory Group, which will look at the common ground between industry and the NHS, of which there is substantial common ground but some conflict of interest.

587. Firstly, what is the White Paper going to make you do differently from what you have been doing before and secondly, what will your relationship be with respect to the two main people in the OST, namely the Chief Scientific Adviser and the Director General of the Research Councils? Would you regard the Chief Scientific Adviser as in some sense your boss?

A. I met him this morning; he did not actually argue that case. We had quite a lot of input into the White Paper and in a sense many of the developments that we have been pursuing over the last two and a half years accord extremely well with the recommendations of the White Paper. I am not arguing it was cause and effect, but I am pleased those recommendations have come out. I am also pleased there is recognition of quality of life as well as wealth creation; health creation and quality of life seem to us to be very important objectives for science and technology. One of the aspects that I particularly welcome is the emphasis on technology foresight. This is particularly important for the health field, where many of the innovations that are coming into health, are now not coming from the conventional territory of medical research. They are coming from material science, from engineering, from electronics, imaging and so on. One of our challenges is to have an awareness of these developments outside the medical research territory. We have developed some technological foresight activities of our own. We

[Chairman *contd.*]

have got a new National Standing Group on Health Technology, one of whose remits is to advise the NHS on new technologies and areas of science that are coming along, that are likely to impact on the Health Service and where there is a reasonable expectation that we can take some actions to accommodate them and so on. So with the technological foresight aspect and the linkage between Government Departments, it seems to me a very positive step. Again the more coordinated interaction between Government Departments fit in extremely well with the health strategy, Health of the Nation.

588. Your relationship with the OST officials?

A. Well, I meet regularly with Professor Stewart and no doubt we shall interact quite closely with the new Director General of Research Councils, particularly since I see the need to relate not only to one Research Council, but more broadly—I mentioned the Economic and Social Research Council, and the new Research Council in Biotechnology and Biology; we already have arranged a meeting to discuss the latter.

Lord Tombs

589. I have two questions. First, an area which always seems to me to be the orphan of health, that is occupational health. The UGC did a report pointing out there were certain university institutes, and it seems to fall within your Department, but there is no real recognition it seems to me of the importance of that area of health. I would like to know how you view that and whether you have any plans for prioritising that area? The second question, you may remember an ACOST Report, dealing with the medical equipment industry, which drew attention to the fact that the NHS is a huge market, poorly coordinated, the industry is fragmented and pretty battered over the past decade or two and there is therefore a large wealth creation possibility, it seemed to us, of identifying equipment which could be developed on a worldwide competitive basis, by bringing together the industry and the market and I would like to know whether you would agree with that proposition and if you did, whether any actions have been progressed to achieve it?

A. With regard to occupational health, we have this year introduced eight new research themes for the Department's centrally commissioned programme. All the research which is funded through the Department, as opposed to the NHS, is being prioritised in relation to eight themes that are heavily orientated towards public health and personal social service issues, including environmental and occupational health. So it will be included as part of that funding mechanism. In terms of the—it was the 1986 ACARD Report, chaired by Sir Rex Richards, I have thought since the beginning of this initiative that we are developing, that this is really a golden opportunity to try and do something about the relationship between the NHS and industry, which is why we are now setting up an NHS industry Research Advisory Group. We also have the Chief Executive of the NHS Supplies Authority on our Central Research and Development Committee, and we have agreement that there will be an R&D presence in the NHS Supplies Authority. Most of the NHS Trusts purchase through them, they are bulk purchasers with huge purchasing power and I feel that we must make that connection. Then the third point is that we have a Medical Devices Research and Development Initiative which we are handling through one of our Regional R&D Directors. A really very key feature of the R&D programme which also concerns alliances between the NHS and the charities, the Research Councils and industry, is that we have now set in place a nationwide network of R&D Directors, so each of the 14 health regions has a Regional Director of research and contrary to some people's expectations, we have actually appointed some very high flyers to these posts, so this is a very powerful new group of people and they are now establishing their networks out to Trusts, Health Authorities, General Practices and so on and also linking with local industry, with Research Councils and, with charities. Because what we do not want are 14 planks of a fragmented programme, I meet with them every six weeks and we have developed the notion of there being a Lead Director for particular aspects of the programme. This does not mean that that region does the research, but the Lead Director is responsible for research management on a nationwide basis and for commissioning, for quality assurance and for delivering the results. The Regional Director for West Midlands has assumed that responsibility for Medical Devices R&D.

Lord Dean of Beswick

590. It is interesting to hear you refer to the Purchasing Authority that has been set up. I think it is approaching the end of its second year, is it not? Did you say the Chief Executive attended the meeting?

A. Yes.

591. Not the Chairman?

A. No, can I explain?

592. I have a specific reason for asking why not the Chairman?

A. The Chief Executive was Regional General Manager for Northeast Thames Regional Health Authority and in that capacity was a member of our Central Research and Development Committee and when he was translated, I saw the advantages of keeping him on the CRDC.

Lord Dean of Beswick] It is not the business of this Committee, but it does not fill me with a lot of confidence when the Chairman of the Central Purchasing Authority was before the Public Accounts Committee of the Commons a few weeks ago in connection with Wessex—I am just making the point. I hope it does work, but I think there could be a bit more selectivity of people they put in charge, because the turnover of this company, if the answer I got from the Minister is correct, when this Purchasing Authority is in full swing, we are talking about a three billion to five billion pound turnover a year. It is a lot of money. It is just a point I am making.

Chairman

593. Is there anything you can say about the criteria by which in future people will be appointed to do these procurements?

A. I do not feel I can. Can I just answer by saying the Chief Executive was already a member of my Committee as a senior manager, and I do see the real opportunity of linking with an organisation that requires reserach—basic criteria by which it purchases medical equipment.

Lord Dean of Beswick] The thing that disturbs me too is every Member of the Board of the Purchasing Authority is already in some respect connected with the Health Service, are they not? Where the seller is also the buyer, I think that is a very dangerous situation.

594. I think you are being pushed outside your role?

A. I think it is outside my role.

Lord Dainton

595. Professor Peckham, you really are unique amongst our witnesses, in that you really are representing by and large the biggest customer that could possibly exist in any area of activity in this country, the Department of Health and its organisation and running. Can you therefore tell us whether in your experience, whilst you have been there and we recognise your appointment is relatively recent, whether there is anything in your experience which has led you to believe that the Science Base needs to change its activities in respect of your interests? We have already referred to the MRC, but there must be other Research Councils involved and universities and on the basis of that experience, do you see any future changes and any need for changes in the mechanism, or whatever, outside that which is already in the White Paper?

A. Firstly, perhaps I could just preface my comments by saying the Department is quite a strong supporter of the Science Base. In 1992–93, departmental funds for research and service support for research exceeded £300 million. Of this, of course, a substantial tranche went to the service support of research in hospitals including the support of clinical research funded by the MRC and major charities. In that sense, it sustains the clinical research of the Science Base. But in addition to that of course, a substantial amount went to supporting university staff. It is interesting the regional directors of research include two newly established chairs, funded by the NHS, one in Cambridge and one at Imperial College.

596. Is that on the initiative solely of the Regional Directors of Research?

A. Those two chairs have been funded by the National Health Service.

597. But by whose initiative?

A. On the initiative of the region. So that there is a substantial level of support to the Science Base, and the Department itself supports 13 research units and recently we announced we proposed to allocate up to £1.5 million a year for ten years to establish a multidisciplinary research centre focusing on primary care. Again that will be based at a university and awarded in open competition. I see we have two really distinct, but interrelated challenges. The one is to relate the health sector to the Science Base, in other words to look from a health sector perspective at basic science and to relate to it and I will just give you an example of how we are doing that. And the second is to use research approaches to sort out some of the anomalies in the NHS including, lack of information of cost effectiveness and on different models of care. So these are two rather separate activities, but both very important. In terms of relating to the Science Base, of course we have a concordat with the MRC and a structural relationship, but we have taken the fist step of identifying genetics as an area of rapidly moving basic science and saying if we were to look at genetics from the standpoint of the Health Service and public health. A number of questions arise, for example, how long is gene therapy going to remain an experimental domain? When will genetic screening for breast cancer become a reality and the whole range of issues of this kind. We convened an interesting group, which is again a mix of scientists and technicians and others and the first meeting was really very exciting, because it already threw up at least one area in cystic fibrosis, where things are moving so rapidly that we have to begin to anticipate quite substantial changes. But our experience has also revealed gaps in the Science Base, so that when we present the problems that we have identified as part of our prioritisation process to the Research Community, there may be a great expression of interest which demonstrates quite a lot of research activity, but for some very important areas we found very little research activity. For example, a capacity to measure the mental health care needs of a population, we rated very highly. We really had very little relevant research activity. So that identifies a deficiancy that we feel we then ought to correct, working with our partners.

Chairman

598. Can you quantify this? How much money have you swung from one field to another field in total, do you think? Have you made minor changes, or have you made major changes?

A. I think there are quite substantial changes happening, which are difficult to quantify. Of course we can quantify the money we are using to support research ourselves, but what is really very exciting to me is that we are beginning to shift some of the funds from applied research to the areas of high priority to the NHS. Let me give you an example. We opened in November a new centre in Oxford, the Cochrane Centre and this centre is concerned with the systematic analysis of clinical trials. It is meant to be not doing it, so much as being the final common pathway for systematic overviews, stimulating and linking up with other groups, for example in stroke, rheumatoid arthritis, whatever it happens to be, so that we have a data base of trials and meta-analyses. One of our major charities has decided to fund a satelite activity which will be responsible for meta-analysis in a specific area of high priority to the Health Service. The Canadians and Danes are funding their own Cochrane Centres to work in a complementary fashion with the NHS Cochrane Centre. The Swedes are already putting money into it as well and other countries have expressed interest.

[Chairman *contd.*]

So I think there is real added value to the NHS investment and other funds are being contributed, both internationally and nationally to suggest work directly relevant to the NHS.

Lord Porter of Luddenham

599. You have not said very much about wealth creation; it is very natural, I suppose. But your priorities are based I suppose, on health creation, are they? You are going to be, as I understand it, very interested in the new Research Council, the new Biotechnology and Biosciences Research Council? Will you be advising them on priorities, in which case, on what basis would those priorities be chosen by you?

A. Can I just say, as far as the mission of our programme is concerned, it is to improve the health and the quality of life of the nation, that is quite clear.

Chairman

600. It is health creation and the quality of life?

A. But it is I believe—and it is a point which we made very strongly in our contributions to the White Paper—that there is a very important wealth creation activity, not only for industry particularly medical devices and the pharmaceutical industry, but also if low cost solutions to many problems of health care can be identified without loss of quality, that has immense export potential, because every developed country is looking in that direction. I believe there is a real common interest with industry. It could be seen as a conflict that the industry develops a very expensive drug and we do not want to use it, but I would prefer to believe that some of our cost effective solutions to health care would also benefit industry, but there of course are other aspects. There is the health of the workforce. There are lost working days and so on. One of the areas in Health of the nation where targets will be set, is low back pain, which has an immense impact on loss of industrial days, so I think there is a whole theme of wealth creation which is very important. On 29 June the Secretary of State is launching a document "Research for Health" which brings the R&D programme up-to-date and in that it will present those arguments about wealth creation and also how we justify an investment in health R&D and what sort of pay-back do we get? Some very interesting areas there. To go back to the last point you raised about the new Biotechnology and Biology Research Council, I see our main links of course being with the MRC and I think we also have common ground with the ESRC, but I also made the point that I do believe that it is our job to relate to the basic science and I do not know how much mileage there will be relating to the new Research Committee, but biotechnology is having a profound impact on medicine.

601. Could I ask you what relationship you have with the Funding Council, talking still about priority setting? It is very interesting that the English say that there is no element of regionalisation in what they do, whereas Scotland and Wales say rather proudly that there is, specially in Wales. To that extent, it is the opinion of Professor Graeme Davies that England is at a disadvantage. I wonder whether you can add to that by saying what your relationship is towards it?

A. Before the last UFC rating exercise I met with Graeme Davies and just had a general discussion about what kind of relationship there might be between NHS R&D and the UFC—very amicable, but we decided to wait until the rating exercise had been completed. Since then, we have reviewed the research and development activities of the eight London post-graduate special Health Authorities and this has been a very major exercise; it has been chaired by Sir Michael Thompson, the Vice Chancellor of Birmingham, with a group of 16 people; each special Health Authority was reviewed by an expert advisory group, all from outside London and it is the first time there has been a focus not on a university but on academic hospitals, posing the questions: What is your mission? How do you take research through to development? How do you export development to the NHS? What are your mechanisms for priorities? In short, a whole lot of questions that hospitals have never actually faced or answered. We have now completed that exercise and the report will be sent to me at the end of June. I describe it, because I think it could be the first step in developing an approach which could be extended more generally to under-graduate teaching hospitals including those outside London and to look not only at the quality of work, but its importance to the NHS. Which then of course leads to an interesting discussion between the Higher Education Funding Council assessing medical school research in terms of quality and the NHS review of R&D in adjacent institutions, the Health Service looking at R&D in terms of quality and importance. Obviously we need to sit down and talk about the relationship and this is what we have arranged to do.

602. Although they are administratively separate, it is in practice extremely difficult to separate a medical school from its teaching hospital or hospitals. One wonders why reviews of this kind do not take place jointly.

A. Exactly, I think there would be much merit in considering a joint approach.

Lord Butterworth

603. Do you anticipate that the changes brought about by Tomlinson are going to create problems for the Medical Science Base?

A. My hope and expectation is that they will substantially strengthen medical research in London. There was a report in 1981 which made certain recommendations and I think there is now a chance of actually implementing some of these. The linkage of medical research with the multi-faculty schools and a rethink of research and development in relation to primary care, a recognition that medical research needs to be placed in the context of other disciplines I think offers many opportunities. In terms of my own role, we have reviewed, as I have mentioned, the special Health Authorities. I have also been in communication with the clinical specialty reviews, to ensure that high quality research is respected when decisions about future considerations are taken and at the same time, we have convened a review of the

[Lord Butterworth *contd.*]

opportunities for prospectively looking at some new models of primary care in London as a result of reorganisation. So I see the opportunities being rather positive.

Chairman

604. Thank you very much, Professor Peckham.
A. Thank you very much indeed.

WEDNESDAY 23 JUNE 1993

Present:

Butterworth, L.	Porter of Luddenham, L.
Chorley, L.	Selborne, E. (in the Chair)
Dean of Beswick, L.	Tombs, L.
Perry of Southwark, B.	

Memorandum by the Medical Research Council

1. *What is public expenditure on the Science Base for?*

1.1 The White Paper "Realising our Potential" underlines the contribution that research can make to improving public services, health and the quality of life and the economic competitivness of the nation, and sets out the Government's responsibilities to support research in science and engineering. We welcome and support these statements.

1.2 Public funds are provided to cover a wide range of research and training purposes; from the MRC's perspective these purposes can be defined as follows:

- funding for both short term and long-term scientific research covering the full spectrum basic-strategic-applied;
- support and training for postgraduate students who will become the next generation of research workers. This includes the provision of appropriate training environments;
- provision of career opportunities for dedicated researchers;
- facilitating and encouraging the transfer of research results to the industrial and/or the health service sectors for the benefit of human health, quality of life and the UK economy;
- promoting environments in which research can thrive.

2. *What are the objectives and priorities of the various funding agencies within Government?—Research Councils, HEFCs, other departments. Are they related? Is an overview required, and do the existing structures (ABRC, ACOST, OST) provide it?*

2.1 The Research Councils share a common goal of promoting a range of high quality basic, strategic and applied research. This goal has been reinforced by the White Paper; the reorganisation of the Councils with a redefinition of the boundaries between them, together with the provision of clear mission statements, will help to clarify scientific remits and objectives.

2.2 The MRC is considering how its objectives and priorities might need to change in the light of the White Paper; while these are not expected to change significantly there may need to be some re-ordering to reflect for example the increased emphasis it is encouraged to give to wealth creation. In the meantime the MRC's current aims and objectives are set out in its Corporate Plan 1993 and Scientific Strategy 1993 which describe its plans for the period 1993-94 to 1996-97. The Council's published aim or mission is to promote research which has as its ultimate objective the maintenance and improvement of human health. To accomplish this mission the Council has set itself central scientific and enabling objectives against which it monitors progress:

Scientific objectives

- To continue to develop research in basic biological science
- To strengthen clinical research
- To respond to the UK's health needs

Enabling objectives

- To promote training and career development
- To continue to support work on a long-term basis
- To create productive research environments
- To work closely with universities
- To increase emphasis on international collaboration
- To develop arrangements for the exploitation and application of research results
- To maximise the Council's income
- To ensure the most efficient, economic and effective use of resources.

2.3 As a fundamental part of the process of achieving these objectives the Council has developed a scientific strategy. The ideal is to develop a strategy which enables the Council to focus the best of modern science on those problems where important health benefits can be delivered, whether in the short, medium or long term. The purpose of the strategy is to identify and encourage the development of environments in which new ideas can emerge, be recognised and flourish, to assist in making the difficult choices between competing programmes worthy of support on scientific grounds and to identify areas where investment can be reduced in order to release finance for new work.

2.4 The MRC's role therefore complements that of the Higher Education Funding Councils which provide general funding for research for use at the institution's discretion. The Council has been pleased to play a part in the Research Assessment Exercise conducted by the Higher Education Funding Council for England which helped to determine individual grant allocations to institutions.

2.5 About 70 per cent of MRC support is directed to or closely associated with universities in the form of grants, training awards or units (40 of the Council's 45 units are embedded in universities). This proportion is due to increase to 80 per cent in the course of the next few years. The MRC has been developing closer contacts with individual institutions, since the effective implementation of strategy involves a convergence of the strategies of the two partners. The approach that we have adopted over the development of the Clinical Research Initiative provides a good example of an initiative built upon the integration of the research plans of the MRC and of a number of universities. Proposals for bringing together biological and clinical scientists in interdisciplinary centres for a concerted attack on major medical problems have been developed on a collaborative basis.

2.6 For a number of years the MRC has set up research establishments in areas of science that were neglected in the university system, because they crossed traditional disciplinary boundaries or were in new fields or in fields where there was little emphasis on teaching. Examples are molecular biology, genetics, virology, nutrition, toxicology and reproductive biology. In the fields of nutrition, toxicology and reproductive biology an MRC unit continues to be the major focus of research and advice in this country and provides long-term investment in relevant basic research areas and in work of direct relevance to industry and Government Departments.

2.7 Government Departments' research priorities are necessarily focused in applied areas because they are policy-related and are more likely to be of a short and medium term nature. It is important that the Research Councils and Government Departments work together to integrate the various scientific research needs of government. The MRC's mission has provided the incentive for establishing contacts and alliances with the Health Departments, the NHS, the ODA and other Government Departments. In particular we regard the new Concordat with the Health Departments as providing a model framework for ensuring consultation and co-operation on research issues of mutual interest. ("Realising our Potential" endorses the principle of establishing such Concordats.) The Concordat prescribes arrangements for discussion of research priorities, research opportunities and development, appropriate representation on Committees, regular contact at officer level etc. These arrangements are being monitored by all parties and are generally agreed to be working well. A similar partnership agreement has been reached between the Council and the Overseas Development Administration, given the common interests in research which would yield results relevant to the health of developing societies.

2.8 The MRC welcomes the Government's intention to develop a national strategy for research and provide a national structure for achieving the necessary overview of research activities.

3. *What are the relationships connecting Government funding of the Science Base, funding by industry and charities, and overseas funding (particularly from the EC)? Various people are "paying the piper": are they calling different or incompatible tunes, and if so is this a bad thing?*

3.1 The Council believes that a diversity of funding interests means a healthier science base. The public sector, industry, charities and overseas organisations all have somewhat different objectives and responsibilities which are bound to make them operate in different ways. What is important is that there should be effective information exchange between the various funding interests so that the potential for co-operation and collaboration can be fully realised.

3.2 The MRC, for example, places considerable importance on developing its relationships with industry with the ultimate aim of improving arrangements for the exploitation and application of research results. The Council's Technology Transfer Group seeks to encourage increased collaboration between MRC-supported teams and industry across a wide spectrum of research and to facilitate the transfer of technology with commercial potential to industry. This often takes the form of collaborative agreements between Council research teams and companies under which the companies make a financial contribution to the costs of a research project for a share in any results of commercial potential eg licensing rights, royalties etc. It can also take the form of facilitating the establishment of "start-up" companies based on MRC discoveries eg Celltech Ltd, Therexys, Cambridge Antibody Technology. The Council has been successful in establishing industry-wide dialogues in the fields of nutrition, toxicology, and neuroscience and actively seeks industrial representation on its Boards and Committees. The Council also has particular responsibilities for training research workers and industry depends to a significant extent on the Council for a supply of appropriately trained staff.

3.3 Unlike the MRC the charities are accountable only to their Trustees and not to the general public as taxpayers and this rightly reflects on how they interpret their responsibilities. The Council attaches importance to building effective links with the medical research charities and exchanging information on policies and priorities. There are numerous examples of joint initiatives and joint funding arrangements. Perhaps the most important recent examples are the joint funding with the Wellcome Trust of the Sanger centre for genome research in Cambridge, the Genome Database and the building for the European Bioinformatics Institute and with the British Diabetic Association for an initiative on diabetes at Newcastle University. In addition information on scientific strategy developments is exchanged with individual charities. For example, the UK Co-ordinating Committee on Cancer Research provides a forum for discussion between the MRC, the Health Departments and major cancer charities. Close links are also maintained with the Association of Medical Research Charities (AMRC) representing 64 members and affiliated charities. Views are exchanged over a range of policy issues of common interest and efforts are made to harmonise policies wherever appropriate.

3.4 Given the growing importance of international programmes the MRC is encouraging greater participation among its scientific staff and is also strengthening its involvement in the policy making and management processes of international programmes. The Council seeks to use the opportunities presented by representation on the committee structure of these programmes (for example the EC's Biomed Programme, the European Molecular Biology Laboratory, the International Agency for Research on Cancer, the Human Frontier Program) to influence strategic thinking and to achieve high scientific standards through good scientific review and evaluation, "added value" for the UK through co-ordination with national priorities and programmes and value for money through effective management. The Council is developing links with other parts of the world including the US and Japan.

4. *What information and advice is needed by those who are setting priorities? How do they know what is going on in current low-priority fields? How do they track developments overseas?*

4.1 The information and advice used by Council in determining its scientific strategy comes from a number of sources. The Boards annually examine their portfolios of research and conduct a rolling programme of reviews of broad scientific areas (field reviews) which involve consultation with the scientific and clinical communities on work currently being undertaken both in the UK and abroad. Review groups set up by the Boards will have memberships drawn from academia, industry, departments, and other bodies as appropriate and may also include members from overseas where developments there may be especially relevant. The specific objectives of reviews may vary but broadly speaking the reviews aim to reach informed judgment on the required future direction and level of investment in research in that field. It is therefore important that advice is taken from a wide spectrum of interests and not just from those working directly in the field. Other advice taken in working up strategy comes from the users of research including Government Departments and industry. The Concordats agreed with the Health Departments and the ODA provide for regular exchange of information on research opportunities and health priorities.

4.2 The annual reviews (or Forward Looks) conducted by the Boards are reported to the Council's Strategy Committee which is responsible for drawing together the various sources of advice on strategy and making recommendations to Council.

5. *How do charities and companies which fund research set and implement priorities? How is it done overseas? Are there lessons here for the government?*

5.1 For the bodies concerned to comment.

6. *The Research Councils have explicit missions. How are these translated into priorities, by whom and on what basis?*

6.1 This has largely been addressed in earlier answers to questions 2 and 4 above. The formal responsibility for articulating scientific strategy rests with the Council. However it is members of the scientific and clinical community, particularly those acting as members of the Council's Boards and Committees, who are best placed to identify both the needs and opportunities (see structure at Annex). The Health Departments, the ODA and other users of research also make contributions to strategy formulation through membership of Council's Strategy Committee and Boards.

6.2 The strategy is not a directive of prescribed routes; rather it is a commentary by the community on the most productive directions for research in the foreseeable future. The planning of research activities to carry through the strategy likewise rests with the researchers who must conceive the particular problems to be tackled and the approaches to be taken.

6.3 In very exceptional circumstances some important and urgent aspects of the Council's portfolio are more effectively launched and co-ordinated through directed programmes with ring-fenced resources eg part of the programme of AIDS research and the Human Genome Mapping Project are supported in this way. With these exceptions the MRC does not allocate funds to Research Boards or to subjects areas. Health Department and ODA views and strategic weighting are taken into account when Boards assess research proposals (whether from the MRC's own units or from university researchers) and make recommendations for funding. All proposals are therefore considered in competition and decisions are made by the Council, advised by the Strategy Committee, at a single award point. The system is therefore flexible and responsive to changing scientific opportunities and health needs rather than imposing some preconceived view of how funds should be spent between fields. Our experience suggests that there are real difficulties in maintaining comparability of scientific standards when funds are carved-up into different budgets.

6.4 The Council also has non-scientific priorities (see objectives listed at 2 above) which enable it to fulfil its mission. For example the Council takes an active approach to training and career development, establishing common user facilities and creating suitable research environments, all of which cut across the identification of scientific priorities.

7. *How are the competing priorities of the different Research Councils (and the Royal Society and the Royal Academy of Engineering) reconciled within the limits of the Science Budget?*

7.1 To date the task of assessing competing priorities for funding has been the responsibility of the Advisory Board for the Research Councils in the first instance. New machinery is being established under "Realising our potential".

8. *Are the priorities of the Research Councils skewed by the boundaries between the Councils' remits, by the existence of Research Council institutes, by international obligations to support "big science", or by anything else?*

8.1 The boundaries of the Research Councils' remits will of course change as a result of the White Paper and a study has been commissioned specifically to recommend the detailed allocation of responsibilities to the new Councils. Whilst it will be helpful to have the boundaries clarified it will become all the more important to evolve and improve the existing mechanisms for close working between the Councils, both to ensure co-operation and to exploit the potential for developing joint strategies eg through cross-representation on committees.

8.2 Of particular importance will be the MRC's links with the new Biotechnology and Biological Sciences Research Council. We will be building on the productive interactions that exist with the Agricultural & Food Research Council—eg the development of complementary strategies (for comparative genome mapping, stem cell biology, new approaches to the immune system); joint funding (eg Neuropathogenesis Unit); regular communication, as with the other Research Councils, between officers on both scientific and administrative activities. There will also be a need to maintain and enhance an effective interface between the physical and engineering sciences on the one hand and the life sciences on the other.

8.3 The MRC's experience in closing one of its three institutes, the Clinical Research Centre (an institution of some 500 staff in the late 1980s), and redeploying the resources to fund the Clinical Research Initiative demonstrates that the existence of institutes does not lock the Council in on a permanent basis to a particular form of support in a particular location, and that transition to a very different configuration of research activities can be managed when this is needed to achieve better value for money.

9. *How is the money transferred from the UFC to the Research Councils being spent?*

9.1 The Research Councils have all given an undertaking that the money transferred from the UFC will be passed back to the universities by way of grants which now make provision for additional direct and indirect costs. The actual yearly expenditure on grants is being monitored by the Research Councils and the ABRC has also been keeping a close eye on the situation.

10. *Additional question: How do you see the impact of the Tomlinson proposals on the medical research base in the UK?*

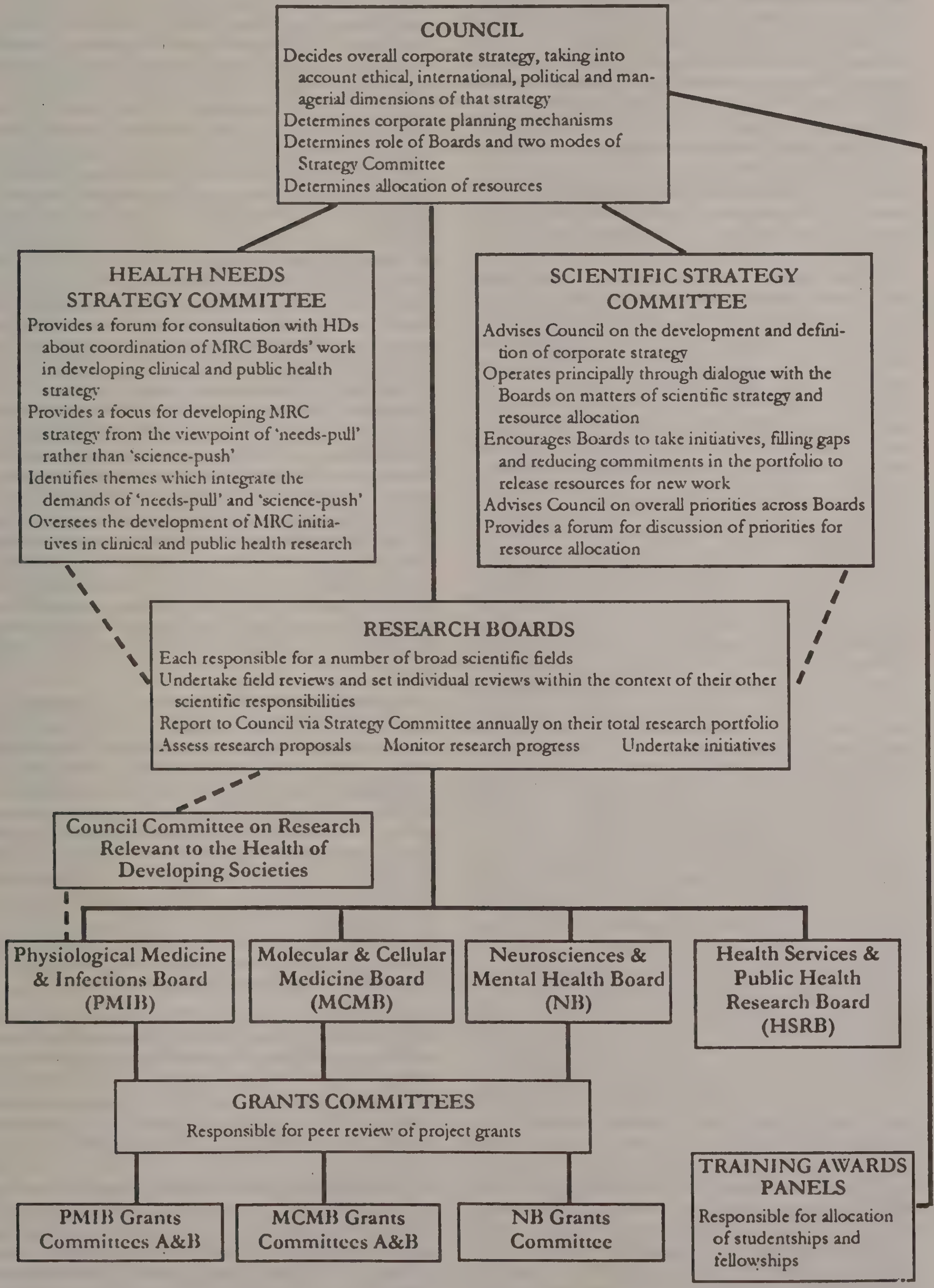
10.1 The concentration of medical schools and postgraduate medical institutes in London has led to a concentration of MRC support for clinical research in the capital, and approximately 30 per cent of MRC funded clinical research (excluding the Clinical Research Centre at Northwick Park Hospital) is in London. A similar pattern is seen in the case of the medical research charities. This distribution of research resources reflects the quality of the clinical and health services research being carried out within institutions now under review. This in turn is due to both the excellence of the individual research workers and the opportunities provided by the academic and hospital environments in which they work. It is therefore of vital importance to the health of the UK medical research effort that weight is given to research issues when looking at the future of London's hospitals.

10.2 However, the Council is not arguing for the status quo. We fully support the arguments for managed change in the configuration of London's hospital services and the development of primary care in the interests of research as well as health care. We have a unique opportunity to develop a small number of centres of excellence, with the emphasis on multidisciplinary working in centres offering state of the art equipment and facilities. To achieve this existing centres need to be closed, others amalgamated and some research teams relocated. In the process, the most important centres should be strengthened and developed to take full advantage of the ever expanding range of important scientific opportunities.

10.3 We are actively involved in discussions with the London Implementation Group and others to emphasise the importance of giving research considerations their due weight when evaluating the outputs from the various review processes and of considering research needs strategically on a pan-London basis.

Annex : The development of scientific strategy

Scientific Strategy is developed through a dialogue between the Strategy Committee in both its modes and the Boards.



COUNCIL

Decides overall corporate strategy, taking into account ethical, international, political and managerial dimensions of that strategy
Determines corporate planning mechanisms
Determines role of Boards and two modes of Strategy Committee
Determines allocation of resources

HEALTH NEEDS STRATEGY COMMITTEE

Provides a forum for consultation with HDs about coordination of MRC Boards' work in developing clinical and public health strategy
Provides a focus for developing MRC strategy from the viewpoint of 'needs-pull' rather than 'science-push'
Identifies themes which integrate the demands of 'needs-pull' and 'science-push'
Oversees the development of MRC initiatives in clinical and public health research

SCIENTIFIC STRATEGY COMMITTEE

Advises Council on the development and definition of corporate strategy
Operates principally through dialogue with the Boards on matters of scientific strategy and resource allocation
Encourages Boards to take initiatives, filling gaps and reducing commitments in the portfolio to release resources for new work
Advises Council on overall priorities across Boards
Provides a forum for discussion of priorities for resource allocation

RESEARCH BOARDS

Each responsible for a number of broad scientific fields
Undertake field reviews and set individual reviews within the context of their other scientific responsibilities
Report to Council via Strategy Committee annually on their total research portfolio
Assess research proposals Monitor research progress Undertake initiatives

Council Committee on Research Relevant to the Health of Developing Societies

Physiological Medicine & Infections Board (PMIB)

Molecular & Cellular Medicine Board (MCMB)

Neurosciences & Mental Health Board (NB)

Health Services & Public Health Research Board (HSRB)

GRANTS COMMITTEES

Responsible for peer review of project grants

PMIB Grants Committees A&B

MCMB Grants Committees A&B

NB Grants Committee

TRAINING AWARDS PANELS

Responsible for allocation of studentships and fellowships

Examination of witnesses

Sir Dai Rees, Secretary, and Dr David Evered, Second Secretary, Medical Research Council, were called in and examined.

Chairman

605. Sir Dai and Dr Evered, we are grateful to you for joining us today and helping us in our enquiry into the priorities for the science base. We have received your most helpful documents: the scientific strategy of the MRC; the corporate plan; and the evidence that you submitted to the Chancellor on the White Paper. Perhaps we may begin by asking you to elaborate on the basis on which you determine the priorities for basic biological science that you refer to in your scientific strategy.

(*Sir Dai Rees*) I should like to make four points, some of which are specific to the MRC in terms of procedure and different as between some of the research councils. First, about five years ago we quite deliberately moved away from what could be called finance-led scientific planning; in other words, a system whereby at the beginning of each financial year one said, The MRC has so much money and we will carve it up. There will be so much for neuro science, so much for psychiatry and so on". The reason for that was that it had been our experience that in increasingly tight financial situations it was very difficult to move the discussion on from how much money various sectional interests would win in the year to what they wanted to do. We thought it much better to turn the whole thing around and make the financial decisions at the end of the process of deciding what to do. How we decide what to do at a macro-level is based on the one hand an examination of what we call in our document the major opportunities for science push. That is based on our analysis of what is happening in the fields of the life sciences relevant to us. On the other hand, there is a needs pull. The needs pull relates to priorities for the health services, industrial exploitation and manpower, training and development. Although the needs pull priorities require to be addressed in terms of strategic or applied research they often point up major areas of fundamental biological science that need to be given priority. For example, the director of research and development for the NHS is carrying out a prioritising exercise that is looking at major causes of morbidity and mortality costs in that service and, within those, which areas are research sensitive. It will not surprise anyone that the first area he identified was mental illness. What do we need to know about mental illness? Short-term options and solutions are limited, though some exist, but there are also long-term areas of biological science to which attention needs to be given. Out of that rather systematic analysis of what is needed, what is happening and growing, we identify areas that are in a healthy, productive state in this country. Since we have moved away from finance-led planning—though in the end it is money that makes the world go round, and even makes scientific projects happen—the discussion of what we will do both in priority areas and areas that arise purely by a bottom up process in the community—has to be ranked, compared and put into some order of priority. We have to do that, since we are not finance-led, by having Board and committee structures which we call vertically integrated and horizontally competitive. That is to say, we have to mix up research in clinical areas with basic research relevant to it and which ought to interact with it. One has to mix up the disciplines so one makes people discuss the relative value for money of investing in areas like cell biology versus immunology. The whole process is oriented towards analysing the merits of this versus that scientific activity. At the end of the year when we have an idea of what the merits are we can decide through our Strategy Committee mechanism how to allocate the money. I believe that that has had a very healthy effect in directing discussions in the MRC towards what it is we ought to be doing rather than who should get what share of the cake. The fourth point on priorities is an issue that cuts across the scientific considerations I have been discussing. One of our priorities has been to move our investment away from free-standing, isolated units and institutes towards university campus-based activities for a variety of reasons, which again I can discuss but I suspect are self-evident to members of the Sub-Committee. The closure of the Clinical Research Centre at Northwick Park and the redistribution of what amounts to somewhat more than 10 per cent of the council's budget between various university campus locations is the biggest example of that process, though there are others. But having decided that we will relocate on university campuses there are still options as to the forms of support on university campuses ranging from responsive mode three-year project grants to rolling programme grants to units. The form of support chosen is that which is most appropriate to the nature of the research to be funded.

606. With that helpful introduction, perhaps we may start by looking at the management of institutes and units that you refer to, particularly working more closely with the university system. I was interested to read your evidence of November 1992 to the Chancellor of the Duchy of Lancaster where, under "The role and management of institutes and units", you said: "The MRC has set up research establishments in areas of science that were neglected in the university system. . ." Could you elaborate how you were able to identify those areas?

(*Sir Dai Rees*) I doubt whether that is a full quotation. I do not have it immediately before me. If you wish, I will address that fragment of it.

607. Perhaps I should read the whole of it: "The MRC has set up research establishments in areas of science that were neglected in the university system, because they crossed traditional disciplinary boundaries or were in new fields or in fields where there was little emphasis on teaching". Could you elaborate on your determination of priorities in this area?

(*Sir Dai Rees*) Again, I think it is helpful to come back to the context of science push versus needs pull. If one wants to seize a great opportunity such as the recent example of protein engineering, that is a field of research requiring an approach based on a combination of chemistry and chemical reaction

[Chairman *contd.*]

mechanisms and biophysics of protein shapes with cell biology and physiological processes. If that has to be organised to be compatible with teaching functions within university departments to the first approximation, even assuming you tune it afterwards, it is difficult to get together in one place the right balance of different disciplines. One would therefore employ biologists, crystallographers and biophysicists as MRC staff to work in the unit—say in a chemistry department—so that within that environment one could build in research activities on the part of senior staff whom one could not justify as departmental members on the grounds of their teaching contributions. That is a good example of the crossing of disciplinary boundaries and is one of the three most recent units we have set up. Another unit that has been set up is concerned with *in vivo* NMR spectroscopy where knowledge of metabolic biochemistry—that is, the biochemical processes that are sensible to measure—plus the maximisation of the power of the technology of NMR and knowledge of clinical conditions, human physiology and so on, again require the bringing together of a combination of strengths that one cannot justify against any one of the normal teaching missions within universities. Another example may be rather driven by the needs pull. When one recognises that for example there are very important strategic areas of science, such as hearing research, nutrition and toxicology—in which the MRC because of its remit needs to promote research and provide experts to advise government—where does one fit such activities within the traditional university system? We need interaction with the universities but it is not reasonable to expect a university host to distort its other activities to optimise itself in relation to that mission. Therefore, we have to put in money and staff. I hope that that gives a clearer picture.

608. To pursue a little further the mechanism for determining the priorities of the units within universities, I think that one of the examples you have quoted is nutrition. Presumably, other research councils have an interest in that area. Is there some mechanism for determining priorities for MRC in relation to other research councils?

(*Sir Dai Rees*) There is quite considerable, though somewhat smaller, activity in another research council that is known particularly well to you, my Lord Chairman. There is both a rationale and a mechanism. Although there is some grey in the middle—which is why one has to collaborate and combine forces—the rationale is that one aspect of nutrition is food itself, how it is grown, what it contains and what vitamins it has. How is the nutritional value influenced by its physical structure, and so on? In general, we say that that is the business of the research council that knows about food production, manufacture, distribution and storage, namely, the AFRC. On the other hand, nutrition is also about the effect on the human body once food is taken in in terms of health, disease and the development of intelligence in children and development of the fetus in the womb and so on. That is the business of the research council which knows about medical science, namely MRC. Nutrition is a continuum from one end to the other which needs the involvement of both research councils and their collaboration. I do not remember whether it was before or after your time as chairman of the Agricultural and Food Research Council, my Lord Chairman, but we now have in place a mechanism that we call the Nutrition Forum which meets twice a year. It is not just the research councils that are interested in nutrition. The Department of Health—especially in view of the publication *Health of the Nation*—MAFF and industry—because it wants to respond to the increasing awareness of the public to nutritional issues—are all interested in the subject. The MRC and the AFRC are taking the initiative in bringing together all those who are interested in it—for example, the Consumers Council because it suspects the food industry of producing junk food and not being interested in nutrition—in order to harmonise priorities. That is part of the needs pull process that I have defined. Although there was a long period—perhaps stretching back decades—when the actions of the two Research Councils were not very effectively brought together, I would claim that we are now doing quite well.

Lord Porter of Luddenham

609. The Medical Research Council is very often quoted as the paradigm of research councils.

(*Sir Dai Rees*) It has been for a couple of weeks!

610. One looks to it for examples. The point we are discussing is one on which you have commented. You have given some rather surprising and encouraging figures. I refer to the question of research in the HEIs and how much is done there. It has often been said to me in the past, "Ah! Look at the MRC. It is the most successful of the research councils. It has all these institutes going at which research is being conducted".

(*Sir Dai Rees*) That is where some of its best research is done.

611. What I find very encouraging is that 70 per cent of your support at the moment is directed to or closely associated with HEIs and it will be 80 per cent by 1995. Can you enlarge on what you mean by "directed to or closely associated with"? For example, would the MRC unit at Cambridge, the unit at Mill Hill and the Royal Postgraduate Medical School be counted amongst the 70 per cent?

(*Sir Dai Rees*) Mill Hill would not be included. I believe that the LMB is not included in that particular figure. However, it may be since it is on the new Addenbrook site. The change from 70 to 80 per cent is a reflection of the completion of the process of redistributing resources from the Clinical Research Centre to university campuses. It may or may not include the redistribution of the Radiobiology Unit which is at an isolated site at Harwell.

612. When I mentioned it the other night to some medical people it surprised them. They said, "Look at the dozens of MRC units that are not in Cambridge". It must be more than 20 per cent?

(*Sir Dai Rees*) I think we have to say a little about forms of support. You can divide up the cake in different ways. There is a faction within the universities who tend to focus on that proportion of our budget that goes to three-year project grants.

[Lord Porter of Luddenham *contd.*]

That is rather small—20 to 25 per cent. They then point to units like the Protein Phosphorylation Unit in Dundee and others which are embedded in university departments and count them out of the equation for reasons of their own because they are not relevant to the particular research interests that they have. This was one piece of our White Paper evidence which was not explicitly taken up. I hope that as the implementation of the White Paper evolves it will come into the picture. We in the MRC believe it is essential that research councils do not use just one instrument of research funding exclusively. I think that if we went over entirely to three-year project grants there would be no possibility of responding to the challenge of wealth creation. It would also be very difficult to respond to the challenge of career development, career provision and so on. In the complicated and strange world of the 'nineties I believe that we have to have a range of forms of support that achieve different things, some of which are very good. They range between three-year project grants for a quick bit of research based on a specific proposal that does not worry too much about wealth or people to other more long-term projects with the aim of achieving different things. I believe that if one adds up what is done across the spectrum in and with university departments through those various modes one would get to that 80 per cent.

613. Obviously, you are working to increase the proportion in HEIs?
(*Sir Dai Rees*) Yes.

614. Do you see any advantages in institutes which are totally divorced from universities, putting the question the other way round?
(*Dr Evered*) Perhaps I may first add a gloss to what Dai Rees has just said. With respect to those units which are already on university campuses, in the past some have been well integrated with their host institutions. Some have operated to a certain extent behind ring fences. It has been very much part of our policy over the years to try to emphasise that there should be a substantial degree of integration so that to an extent they are looked upon as part of their host institutions but for the mutual benefit both of the unit and the institution. I think it is worth adding that that also reflects very much our policy with respect to future major investments where we are looking to identify areas where our own strategies converge with those of universities. Where they do that provides the basis of negotiation, which may involve a process of redefining strategies on one side or the other or both.
(*Sir Dai Rees*) I believe that to be a very important point. Although I have painted a glowing picture of how it is all embedded and so on, there has often been a lack of interest in universities and people in units have just got on with their projects and not got involved in wider university debate. That is definitely something on which we must work.

615. That dates back to your first magnificent unit in Cambridge. Cambridge University did not want to know?
(*Sir Dai Rees*) Exactly. There may have been a certain amount of insularity in that regard. That is perhaps a paradigm. There was also an issue raised by the personal approaches to research and the chemistry of it not mixing. The ethos of the LMB was very much about dedicated full-time work, that is, working day and night and being committed to a research problem, whereas the ethos in some parts of the university was more about being a generalist who picks up research and then perhaps puts it down again. I think that those approaches do not always mix. As to whether I see a place for a free-standing, independent institute, in the discussion leading up to the White Paper there has been an interesting and anxiety-provoking discussion about the role of institutes in research councils. Happily, I think that the answer that has come out is a very enlightened one. The phrase used in the White Paper is that research establishments, including institutes and units, can be invaluable instruments of the strategy of research councils. For example, in this country we have been very concerned about the state of British molecular neurobiology. We really need some centre of excellence somewhere, that is, somewhere where people can be tried and standards can be set. After a number of attempts to do things in a more dispersed way we have eventually decided to set up a fifth division within the Laboratory of Molecular Biology in Cambridge which will look at the protein structure in molecular biology in relation to the nervous system and build upon it.

616. Will that be done in association with the university?
(*Sir Dai Rees*) Yes. The point I am trying to make is that that is an instrument of council strategy. It is a focus of excellence that we feel the country needs to establish. It often means a degree of dedication. It always means doing a reverse brain drain job where you get somebody back from abroad and convince him that he can concentrate on his research and be resourced at a level of work equivalent to the best centres overseas. By definition, one begins to define some job other than a Lectureship in a Department. If it comes to the point—as it may do—where one cannot have both a full-time dedicated approach to the job of research and be able to interact effectively with the university system and there is a question of what gives, there will be circumstances in which it is the contribution to general university life that has to give.

Lord Tombs

617. I should like to ask a couple of questions on the corporate plan. On page 8, half-way down, one of the sub-objectives is to promote and support research relevant to the health of developing societies. Plainly, there are ways in which that is of interest to United Kingdom health. I want to be assured that it is supplementary to that aim and not diversionary from it, or that if it is diversionary the ODA will pay?
(*Sir Dai Rees*) It must not be diversionary from it. I assert that it has to be justified in terms of the national interest and the national role.

618. In health terms, not diplomatic terms?
(*Sir Dai Rees*) It may even be in diplomatic terms. For instance, the Overseas Development Administration puts £1.5 million into it.

[Lord Tombs *contd.*]

(*Dr Evered*) With respect to our tropical programme the ODA contribution is about 25 per cent. We are now using what may be regarded as the more politically correct phrase "the health of developing societies". That programme now covers areas recognising that our focus should not just be upon tropical societies but developing societies within Europe.

619. Given the fact that your central remit is to improve United Kingdom health, the point I seek to make is that in so far as one seeks to do good for others the bill should be paid in this case by ODA. If it is work in the area of malaria where perhaps the United Kingdom has an interest that is fair enough?

(*Sir Dai Rees*) That is true. I think that it can be split into two parts: the ODA and Department of Health interests. There are concerns in the Department of Health for example about environmental health hazards in the former Eastern Europe in which it is felt that for national reasons we ought to take an interest.

620. If I may be presumptuous, I suggest that he who calls the tune should pay the piper?

(*Sir Dai Rees*) That is absolutely right.

621. On page 11 another sub-objective is to strengthen capability in health services research. Perhaps you will elaborate on that. Does it involve supporting and developing the NHS capability?

(*Sir Dai Rees*) It does. It takes one back in history to the Rothschild principle under which there was a certain proportion of each research council's budget assigned to the interests of customer departments and which operated under a system that did not appear to work very well. As far as the MRC was concerned, it operated for only a very short time. We reached a new agreement called the Concordat by which we got the money back but accepted the commitment to work on their problems. That is what it means. With the setting up of the new Research and Development Directorate within the NHS we have to decide what kind of health service research is appropriate for us and what kind of health service research is appropriate for them to do. Generally speaking, if it is pretty high science which involves the application of results of other projects that we are doing and bolting on health service interests then it is our business, whereas if it is about operational research in running an ambulance service for example then it is their business.

Lord Butterworth

622. One point I should like to have cleared up concerns your mission. Lord Tombs said that your mission was related to the United Kingdom. Do you so interpret it, or do you interpret it wider than that?

(*Sir Dai Rees*) That is an extremely good point. Our mission is not specific to the United Kingdom. The way we see it is that we are funded by the British taxpayer and since the United Kingdom as a country is a citizen amongst the countries of the world and wishes to be a good citizen, we should take an appropriate level of interest in health issues globally.

623. We have a great reputation for medicine, including tropical medicine, do we not? Presumably, that must come within your umbrella?

(*Sir Dai Rees*) It does. But there are two reasons for that. First, there is a great deal of knowledge of biological and medical phenomena and mechanisms to be derived from studying, for example, malaria. I would be prepared to be accountable for a proportion of our research activity in that on those grounds. I would put my hand on my heart and say I can justify to the British taxpayer that in those projects the interests of the MRC in understanding biology and medicine coincide with the interests of the third world. But in addition given that we are doing this research it can be an instrument of policy and overseas aid. For that reason we work together with the ODA.

Lord Tombs

624. On the question of public health research, there were two things I looked for but did not find. They may be subsumed elsewhere. One was the evaluation of established regimes for treatment, therapeutic or surgical. Things go out date. There are many arguments going on about the soundness or otherwise of particular regimes. Is there any programme in the MRC to deal with that? The second area concerns occupational health. Again, I found no reference to it. That area has always seemed to fall between a number of different stools, including the MRC?

(*Dr Evered*) I think that the first question is relatively straightforward. Lord Tombs is absolutely right. There is a considerable need to evaluate existing practices. Members of my profession are singularly poor at throwing away outmoded approaches to treatment. This is an area in which Professor Peckham's new research and development division is putting a lot of effort. Some of that effort will involve the MRC. They too see this as also being their responsibility. We have a major responsibility for trials. That is a very important component of health technology assessment. We are and have been reviewing the process by which we develop trials to make sure that they deliver satisfactorily answers that can be fed through into practice.

(*Sir Dai Rees*) You will have seen the Concorde trial discussed in the newspapers. With our French collaborators we were able to mount a trial which was more definitive than anything that was possible to achieve in the United States. It needed the MRC to do that.

(*Dr Evered*) As to occupational health, I agree that it has always been something of a cinderella part of the profession. Responsibility has been very substantially divided. We certainly make some research contributions but they are inclined to be categorised under other sub-heads. Clearly, some of the work that we do in the Applied Psychology unit on the behavioural side, or some of the work done on toxicology, is relevant. There are a number of other areas in which we do work that are relevant to occupational health.

625. There are vacancies for a leader in this area. I suspect you are saying that the MRC does not see itself as a leader?

[Lord Tombs *contd.*]

(*Dr Evered*) I think it would depend on what we would see as being the nature of the lead.

(*Sir Dai Rees*) We still have a member of the Health and Safety Executive on our council. In all honesty, however, this is a partnership that needs revitalising.

Baroness Perry of Southwark

626. I want to ask you about the Tomlinson proposals which clearly will have an effect on staff in the medical research field. How do you see that impacting on the work of the Council?

(*Sir Dai Rees*) We are very glad that you have asked the question.

(*Dr Evered*) The first thing to be said is that the need for change in the pattern of provision of health services in London is fully recognised by ourselves. The two broad principal recommendations we very much endorse are the reconfiguration of the hospital services and the improvement of the primary care services. Having said that, London is important from the point of view of both education and research. About 30 per cent of our clinical research activity is carried out in London. We have taken the view throughout that in the process of reconfiguration there are some very real opportunities, in particular in clinical and health services research. For example, we see opportunities to create an environment similar to that we have been trying to establish through our clinical research initiative whereby we bring the basic sciences and clinical research into closer apposition to the benefit of both. We also see opportunities with respect to health services research and, in the development of primary care, greater opportunities for the conduct of research within the framework of primary and community care services. That will be increasingly important as time goes on. Having said that, the review processes that have been put in place following publication of Tomlinson have by their nature been piecemeal. They have not covered all components of the system. Our major concern has been that there should be proper mechanisms put in place for integrating the outputs of the various review processes. We believe that that is important not only in the interests of developing sensible patterns of care delivery—which at least I as a resident of London am keen to see—but also so that the contribution which London makes to some areas of research is set in the national context and the decisions are not simply transferred to purchasers within the reformed health service who inevitably have local considerations in mind when making their purchasing decisions. There are real opportunities here. Some of the changes that are proposed will lead to a coalescence of research activities around Bloomsbury, University College, the Middlesex, the Institute of Neurology and the Institute of Child Health. That we would regard as very positive. It would bring together some of those clinical activities and some of the undoubted strengths of the biological sciences of University College London. We can see opportunities in West London around the Royal Postgraduate Medical School where we have a major investment, but it also incorporates other institutions in West London. South of the river, focusing on the three major teaching institutions in the South East Thames region—St Thomas's, Guy's and King's—there are one or two institutions of importance in the national context, for instance the Institute of Psychiatry. The opportunities are there to be taken. We are working very hard in discussion with our colleagues in the Department of Health, the London Implementation Group, the university and other relevant agencies to try to ensure that those opportunities are clearly identified and taken. In particular, we have been stressing the point that this is a once in a lifetime—perhaps once in a century—opportunity to create improved structures in London. We need to be forward looking in identifying those opportunities, not simply trying to create structures that solve yesterday's problems.

Lord Chorley

627. You referred earlier to flexibility. How much flexibility in practice do you have? I suppose that it can be judged at different levels. Is there enough flexibility to move funds around in different fields of research? My impression is that in some research councils there is very little flexibility.

(*Sir Dai Rees*) In the past we have always been able to achieve enough flexibility. The closure of the clinical research centre was a means of generating flexibility; it released resources that we could spend on new activities.

628. Would it be 5, 10 or 15 per cent of budget?

(*Sir Dai Rees*) Within what we call the direct support side—institutes and units that form long-term investments—we aim to release 20 per cent of the investment each year on the basis of what is reviewed. We review on a five-year cycle. That is our target, and we have been able to achieve it. There is inflexibility in terms of career appointments, buildings and so on, but one tries not to allow those to be an excuse to freeze assets. The discipline that we impose on ourselves is that in relation to all the work we do under that heading we must identify the bottom 20 per cent somehow or other to make that available for new ventures.

629. That is very impressive.

(*Sir Dai Rees*) It is 20 per cent on the basis of a five-year cycle, or 20 per cent of what is reviewed each year; obviously there must also be continuity in the remainder, otherwise, it is not long-term research.

Lord Butterworth

630. Perhaps I may give Sir Dai a question for a written answer. I refer to the new Biotechnology and Biological Sciences Research Council. What kind of machinery do you see being set up in order to order the priorities between yourselves and that council, and would that machinery also be adequate to prevent duplication?

(*Sir Dai Rees*) I am prepared to break the speed limit and answer the question now, if that is agreeable to the Sub-Committee.

Chairman

631. Perhaps you will also tell us whether you think the Director General of the Research Councils will be effective?

[Chairman *contd.*]

(*Sir Dai Rees*) I am not concerned in that regard. On that question, what the White Paper is doing is making all the research councils similar sorts of animals. I believe that that will improve relationships. The AFRC and MRC have been the same sort of animal. We have the same sort of structure with non-executive chairmen and are both mission oriented. In recent years we have collaborated very effectively, particularly in areas like genome research. They have their genomes and we have the human genome. We have collaborated in immunology, neurobiology and so on. It works all right. If we are doing some strategic planning and see that it affects them we ask them to send representatives along to look after their interests and bolt on their bits, and vice versa. There are no secrets, surprises or attempts to steal marches. We plan things together where they ought to be planned together. I am now more concerned with the consequences of removal of biology from the SERC on the interface between chemistry and biology. We need to have biological chemistry which is proper chemistry correctly reviewed, promoted, encouraged and so forth. That will be a challenge. I do not think that moving biology was wrong, but special attention will need to be given to make sure that a gap does not open up and the whole area of biological chemistry or physical biochemistry becomes neglected in this field.

Lord Porter of Luddenham

632. Do you think that chemists should be represented on that council?

(*Sir Dai Rees*) I think that some mechanisms will have to be found. It will be the job of Sir David Phillips and his boundary study to sort it out. The MRC has certainly drawn his attention to the problem and suggested certain mechanisms he may like to think about that may not be too many miles away from that.

Chairman] Reluctantly, we have to draw the evidence to a conclusion. Thank you very much for your indulgence and help.

Memorandum by the Committee of Vice-Chancellors and Principals

INTRODUCTION

1. This response follows the questions listed by the Select Committee in the order set out in the call for evidence.

Question 1: What is public expenditure on the Science Base for?

2. We take the Science Base to mean all research and research training funded by the Higher Education Funding Councils and the Research Councils and performed by higher education institutions and the Research Councils. In our view the purposes of Science Base expenditure are:

(a) to advance knowledge and technological capability;

(b) to train the nation's research and other highly qualified manpower at postgraduate level;

(c) to develop, maintain and deliver high quality, world class, research output both in fundamental research and in areas with promise of commercial exploitability.

A note summarising Science Base expenditure in 1992–92 is attached. Most of the research performed by HEIs which will have immediate application is funded from the non-Science Base sources.

3. The ultimate objective of the UK Science Base, in an increasingly world environment, is to underpin wealth creation and to secure economic, social and cultural benefits. It is a long term investment in manpower, knowledge and technology.

Question 2: What are the objectives and priorities of the various funding agencies within Government?—Research Councils, HEFCs, other departments. Are they related? Is an overview required, and do the existing structures (ABRC, ACOST, OST) provide it?

4. The objectives and priorities of the various agencies should be distinctive but complementary. Plurality of funding is beneficial but a strategic overview is vital. In so far as research training in HEIs is concerned, the objectives and priorities of the Research Councils and the Higher Education Funding Councils (HEFCs) are different. The HEFCs have a wider role, in terms of subjects and purpose. In particular it is their responsibility to ensure that a high quality infrastructure is maintained in HEIs through selective funding for research and research training across the whole range of subjects. The roles of the Research Councils are more narrowly focused with distinctive missions in their own areas.

5. Attached is a copy of our submission to the Chancellor of the Duchy of Lancaster on the future of science and technology *(not printed)*. We said that there should be a single advisory body with an independent chairman combining the roles of the ABRC and ACOST. It is essential for the voices of the HEFCs and the various beneficiaries of the Science Base, particularly industry, the charities and the health service, to be heard. It is not necessary for all Government Departments to be represented on such a body, a key role of the Office of Science and Technology should be to ensure effective coordination of research and development

between Departments and their agencies in the context of a strategic overview to which the advisory body is a key contributor.

6. There is a need for a coherent science and technology policy and a strategic view of the areas of research which should be supported or protected and of the skills and expertise which need to be safeguarded and developed. At present there seems to be no clear framework for the development and promulgation of policy.

Question 3: What are the relationships connecting Government funding of the Science Base, funding by industry and charities, and overseas funding (particularly from the EEC)? Various people are "paying the piper": are they calling different or incompatible tunes, and if so is this a bad thing?

7. Different funding bodies have their own missions, objectives and priorities; so do individual institutions of higher education. Plurality of funding and diversity of mission are supported by CVCP. It is important that Government and EC funding are complementary (the principle of subsidiarity) and that Government funding provides the infrastructure to enable institutions to accept other funding for research. Near-market research should be fully funded, including infrastructure costs, by industrial and other sponsors. Although different agencies are calling different tunes, which may or may not be incompatible, the diversity of institutional missions and priorities ensures that all tunes are played somewhere in the system. The Government's strategy for the Science Base must encourage such diversity of mission.

8. The problem of shared cost funding of European Community contracts remains a serious one for HEIs. Institutions in the UK are at a disadvantage compared with their counterparts in other member states where universities receive adequate funding to cover the 50 per cent of the full cost contracts which is not met from EC sources. This is an issue which must be addressed by the UK Government if HEIs are to compete effectively for EC contracts and to ensure that the UK's investment in the EC research and development Framework Programmes is recouped.

9. The relationship between Government funding of the Science Base and industrial support of research is a key issue. We support the development of the missions of the Research Councils with reference to the underpinning of wealth creation, through the funding of basic and strategic research. The Research Councils, often in partnership with Government Departments provide substantial support for collaborative research with industry, for example, through the LINK programmes. These relationships need to be clarified with the aim of maximising the commercial exploitation by industry of the output of the Science Base, but it is important that redefining the missions of the Councils does not result in a switch from industry to the Exchequer in funding for much near market research which should continue to be the responsibility of industry.

Question 4: What information and advice is needed by those who are setting priorities? How do they know what is going on in current low-priority fields? How do they track developments overseas?

10. The funding agencies must consult the research community, higher education institutions, industry, charities and others in order to have a clear and correct view as to which are of the highest priority, which are becoming less important, and any other factors that will help to set approaches correctly. It is particularly important to make sure that the advice of the most creative members of the science community is sought. The views of the funding agencies will be made known in their forward planning and in their advice to the ABRC (or its successor).

Question 5: How do charities and companies which fund research set and implement policies? How is it done overseas? Are there lessons here for the Government?

11. These are questions for the charities and the various representative industrial groups to answer.

Question 6: What are the objectives and priorities of the HEFCs in funding university research though block grants, and who is setting them and on what basis?

12. The HEFCs will themselves have stated their objectives and priorities. Their broad role is selectively to allocate funds for teaching and research taking account of the missions, strategic plans and performance of individual HEIs. In relation to the Science Base we think their objectives should be to ensure the maintenance of the infrastructure necessary for institutions to deliver high quality research and research training, taking account in general of any broad steer from Government on areas of strategic importance to the nation in terms of highly qualified manpower and priorities in research. But they should not attempt to be over-prescriptive in their own steer to institutions. The effectiveness of the Science Base depends on a partnership between HEIs and the Research Councils, with influences from other sponsors of research and research training. The evidence collected by the HEFCs on research output and performance, and on sources of external funding, complements the information provided by individual HEIs in their strategic plans and departmental research plans.

13. The role of higher education in research training is a crucial aspect of the transfer of the results of research from the Science Base to employers in order to underpin the economic, social and cultural well-being

of the country. The ABRC and the HEFCs have jointly initiated a study of the costs of postgraduate research training and of the mechanisms for its support, taking account of the responsibilities of the Research Councils, the HEFCs and other bodies.

Question 7: How is each university's block grant distributed between departments and on what basis?

14. Universities are selective in their distribution of research funds between departments, but mechanisms vary. Some reflect in their own resource allocation procedures the selective approaches of the Funding Councils in terms of distribution between subjects. Some have established distinctive criteria and principles for selective support of research in combination with the approach of the HEFCs. These mechanisms have been sharpened by the outcomes of Research Assessment Exercises and the changes in methods of research funding by the HEFCs. Money is now allocated only in respect of staff judged to be active in research and producing work of quality. The development of arrangements for accountability for the use of HEFC research funds, coupled with the impact of the new arrangements for dual support of research, will also influence the internal distribution of funds by institutions.

Question 8: What are the impacts in priority setting of:

(a) *the abolition of the binary divide?*

15. Selectivity is now of even greater importance, to ensure that research funding is not spread more thinly within the higher education sector. Most of the former polytechnics participated in the 1992 Research Assessment Exercise. For this purpose they needed to establish research plans and be clear about their priorities for developing research strengths in the context of their institutional missions. All HEIs are now competing for HEFC research funds on the same basis. However, since such funding is now related substantially to judgements of past research performance, the new universities—which have not in the past received research infrastructure funding on a significant scale and are only now to receive limited funding for the development of research strengths—will be bound to take the view that they are in practice still competing at a disadvantage.

(b) *the regionalisation of funding?*

16. Within a broadly similar general framework the HEFCs have adopted distinctive approaches to the funding of research taking account of regional differences in institutional research strengths. However, the 1992 Research Assessment Exercise was UK-wide; we do not favour the regionalisation of research funding, which should be funded on the basis of quality, not location.

(c) *the shift of emphasis from core funding to project funding involved in the transfer of £150 million pa from the HEFCs to the Research Councils?*

17. Institutions will clearly wish to establish priorities which maximise the opportunities for gaining funds from the Research Councils under the new arrangements and for improving performance in the next Research Assessment Exercise. The Research Councils are now responsible for funding some of the costs of the research infrastructure in HEIs. This means that Research Council strategies and programmes will have a bigger impact on HEI priorities than hitherto. Both the Research Councils and the HEFCs have indicated their intentions to be more selective in the distribution of research funds.

(d) *formula-funding, research rating and moves towards an R-T-X model?*

18. The answer to this question has largely been covered above. As a result of increased selectivity of funding, HEIs will have to play to their strengths in research and teaching in individual subjects. The distribution of excellence in research will also have an impact on strengths in research training which may lead to the emergence of graduate schools.

[Questions 9-11: These we regard as primarily for the Research Councils and others to answer]

Question 12: How is the money transferred from the UFC to the Research Councils being spent?

19. The University Finance Directors have recently completed a study of the effects so far of the transfer of funds from the UFC to the Research Councils.The first year of operation of the new arrangements has not yet been completed but it is clear at this stage that the Councils are not spending the money transferred to them in the pattern which was intended. We accept that all the money will be spent on research in HEIs. It was a requirement of the transfer that it should be neutral in terms of the overall volume of research funded by means of research grants. However, there are signs that some of the money transferred is being awarded for costs for which the Councils had responsibility previously (eg, research assistants and equipment) rather than for "new style" direct costs (departmental research support staff such as technicians). The University Finance Directors' report has been drawn to the attention of the OST, the ABRC, Research Councils and HEFCs.

SCIENCE BASE EXPENDITURE, 1991-92

	£ million
1. Higher Education Funding Councils (including humanities research and postgraduate research)	c. 880
2. Research Councils and other Science Base bodies	c. 950
— including expenditure on research and training in HEIs	435
3. Other expenditure on research in HEIs funded by:	
— charities	224
— Government Departments	144
— UK industry and commerce	121
— health authorities	209
— European Community	592
— other UK and overseas sources	123*

* includes all "non-dual support" income for some institutions where no disaggregated information was available.

Examination of witnesses

Dr Clive Booth, Vice Chancellor, Oxford Brookes University and Vice Chairman of CVCP, Professor D E N Davies, Vice Chancellor, Loughborough University, and Sir David Smith, Vice Chancellor and Principal, Edinburgh University, Committee of Vice-Chancellors and Principals, were called in and examined.

Chairman

633. Thank you very much for joining us today. Is there anything that you wish to say in a preliminary way?

(*Sir David Smith*) We are a delegation from the Committee of Vice-Chancellors and Principals. You may have some questions on which the Committee has a stated position, but there may be a number of matters on which the Committee has not formulated its position, in which case we represent an interesting diversity in universities. To introduce myself, I am Vice Chancellor and Principal of the University of Edinburgh which is a large, old, civic broad-based university. On my left is Dr Booth who comes from an institution that has newly acquired university status: Oxford Brookes University, formerly Oxford Polytechnic. On my right is Professor Davies from Loughborough University of Technology, a technologically-based university.

634. Perhaps we can begin by referring to diversity and diversity of funding. Referring to the helpful paper that you have already submitted, you say that plurality of funding and diversity of mission is supported by the CVCP. Is that an advantage or are there problems?

(*Sir David Smith*) It is undoubtedly the case that in general diversity of funding is an advantage, just as having a range of institutions with diversity of missions is an advantage. But I would not like to paint a picture that is wholly white. There are difficulties. Perhaps for some universities, particularly those in the medical field, one of the bigger problems is not so much missions as procedures. I refer specifically to medical charities which do not pay overheads. Under the new system and the shift of DR tension in the system is being created.

635. What about European Community funding?

(*Sir David Smith*) We refer to that in our evidence in paragraph 8.

(*Professor Davies*) I think that for some time universities have been concerned at the low level of the overhead component associated with EC funding. It corresponds approximately to 20 per cent. It is fixed by the European Commission itself. Over and above that there is a small amount of money which is paid by the funding council as part of their formula-funding. That is the CR component. Until recently that worked out at about 3 per cent in addition. There has been a recent change in the formula which brings it to about 5 per cent. If you take a research project from the European Commission either you must do it extremely cheaply or there must be a hidden subsidy from other activities. It is highly prestigious and good work but it is not seen as part of the science base in the sense it is not funded as part of the dual support system. Obviously, we have to fund it the best way we can, but compared with many European universities we are at a significant disadvantage.

636. I should like to move on to the higher education funding councils. You say that they should not attempt to be over-prescriptive in their own steer to institutions. I suppose that between you you have experience of two funding councils. Are they over-prescriptive or is it too early to say?

(*Sir David Smith*) I come under the Scottish funding council. Just over a year ago it was almost non-existent. It has had to build itself up from almost nothing with no building into a system which can undertake all the complexities of funding 25 institutions. It has not yet reached a stage where I would describe it as being over-prescriptive. I cannot speak for the English position.

[Chairman *contd.*]

(*Dr Booth*) I think that the English funding council has been quite successful in not trying to be over-directive of institutions. There has been a tradition that we receive funds via a block grant. Although the English funding council gives what it calls "a broad steer" within that we have a fair measure of discretion. That is very important and most welcome. It increases the chance that the judgments of some 100 universities collectively are likely to be better than the central judgment of a few bureaucrats. I think that that is much to be desired and it is certainly appreciated by researchers within universities.

(*Professor Davies*) I believe that to some extent this is coupled with the growing interest in increased accountability. I do not think that we would wish in any way to disapprove of that development. But the way that funding comes to us is such that, though it is not constrained, it is very clearly defined; in other words, there are 70 different subject areas and different sums of money under each one of them. This year we are told very clearly that we can ignore those headings and redistribute it in any way we like. At the same time, we are told that greater accountability is required. I think there is a fear that if one goes too far down the "accountability" line—of which we are in favour—one will find that our funding becomes very tightly constrained.

637. Do you see the danger of over-prescription as a threat to the science base as far as the universities and institutes of higher education are concerned?

(*Sir David Smith*) If there were to be a move to a greater degree of prescription than at the moment the science base would undoubtedly come under some threat. The science base is better managed on site, not at a distance.

Lord Porter of Luddenham

638. As you know, the Sub-Committee is trying to find out how priorities are set. You say that that is better done on site. That leads to the very good question: how do you do it on site? We have three vice chancellors before us who have that job. They have all their faculties before them, in all senses of the word, and have the very difficult job of deciding how much of the money should go to nuclear physics or the specialists in beetles, or whatever. What are your criteria for setting priorities in scientific research?

(*Sir David Smith*) In this instance the CVCP has no position: you will have to listen to three different accounts.

639. I am really asking three vice chancellors.

(*Sir David Smith*) If I may lead off, in my university we now have a system by which the university establishes a strategy that runs on an annual cycle. Outline plans are developed in a top down fashion. During the academic year they go down to departments and come up as a combination of strategy and budgeted plans. Decisions are then made as between plans according to the strategy; in other words, we do not allocate according to the formula, because that will be an abrogation of management. We allocate according to plans in the context of a longer-term strategy. Because we generate little free money of our own we are very much the prisoners of external priorities, but we can make choices. For instance, my university can choose whether or not to bid for an interdisciplinary research centre. If it does so it realises that it has to allocate buildings, staff and other facilities to that. That has to be consistent with an overall strategy. Within the universities there are constantly competitions for which chair should be filled, assuming only one can be afforded. Again, that decision is made according to strategy. Inevitably, that strategy is determined by external forces. For example, in my university we support HIV research. We have some excellent researchers and have a unique population of HIV people to serve. If the MRC decided not to fund HIV that would make us change our strategy. In small budgetary areas we can do our own thing. As an example I quote my own university. Because of some of its past success in interdisciplinary research into applied linguistics and artificial intelligence, the university is a European leader. We strongly believe that we should promote interdisciplinarity in any case. Such rigorous literature as exists about the origin of innovation makes it clear that it relies very strongly on interdisciplinarity. We have a working party that comes up with a strategy of how to prevent inter-faculty boundaries militating against it.

(*Professor Davies*) There is a difference at Loughborough. Although we agree with the idea of planning we rely much more on a formula basis for a particular reason. We believe it is important that the individual subject areas understand the criteria used to fund them so they can develop their plans in a way that optimises their funding. This also means that departments are not really in competition with each other in their own institutions. They are in competition with other departments of the same sort within the whole university sector. For that reason we place much higher emphasis on a formula basis that broadly reflects the formula used by the funding councils. We then modify that in a number of ways. First, we will have certain internal priorities, one of which at the moment happens to be to give increased emphasis to research. Secondly, we provide some funds to start up new activities by a peer review internal process which is quite apart from the selective core funding of departments from block grant. We also undertake an internal process to update the research selectivity rating. Between each exercise we look at whether the performance of the department in terms of publication is being maintained, is getting better or is slipping. Finally, there may be other ways in which we modify the formula for what I may describe as the perceived misjudgements by the funding council. A very good example of that is the latest funding for research which produced strange variations between subject areas. The sum of money is divided by the number of active researchers. One may imagine that that gives some measure of how expensive research is in different areas. It seems to form a strange pattern. It happens that chemistry is rather better than physics; mathematics is substantially better than engineering; and computer and material sciences are one quarter of other subjects. We found this unacceptable for internal allocations and we adjusted the figures.

(*Dr Booth*) We have a mixture of both elements you have heard about. We come to research with only

[Lord Porter of Luddenham *contd.*]

a modest track record. We have not been funded through the dual support system, but we have been comparatively successful in the recent research assessment exercise to the extent that my university, which is small, has £1.6 million to allocate. We have taken a combination of the Loughborough and Edinburgh approaches. I did not realise that until I heard my colleagues give their accounts. Part of the money we contribute is on the basis of the record of subject areas in the national peer review research assessment exercise. But even in that case they have to use the money on a project basis and they will be held to account for it over time. It is not that we hand the money across and say, "That is yours. Go and do what you like with it". They must define projects that come to our research and consultancy committee and are approved by it. Another part of the money is allocated competitively. That is in recognition of the fact that we want to give some people who have bright ideas and the capacity to do good research the opportunity to get on the bottom rung of the ladder. There is a research competition. We have a panel headed by an external independent chairman. That panel adjudicates between the bids. I believe that we have 20 times as many bids as we shall be able to support. I think that that is healthy and important, particularly in an institution like mine which has not been able to support much research in the past.

Baroness Perry of Southwark

640. I would like to consider what is happening nationally in terms of funding council research support. If one stood back from it and did not look at it from the point of view of the institutional interests, obviously there would be a question as to whether in future the strategy for the science base in universities should be to take up more of the funding councils' money into the 5s and possibly the 4s, or whether as a country we wished to flatten out the science base and have a much wider and perhaps more modest range of effort. Where do you stand on that?

(*Sir David Smith*) Again, this may be a question to which you will get three answers shaded in different directions. For a university like mine which is large and has a very substantial research income, we see the merits of concentration and selectivity. I do not in any sense deny the value and virtue of the very clever individual who works more or less on his own. But the values of the larger gathering are various. In an odd way, as I observe my university it is easier to preserve good young people who have not yet got a permanent post within a larger system because you have various pots of money coming in and posts coming through. You can play the system to do that. Where you get lots of clever young people together they interact and develop a life of their own. What one has to be careful about is when a larger unit begins to get stale and simply trades on its past reputation. That is where some degree of management takes hold, but the research assessment begins to take it into account. One sees a unit sliding down. These days after each research assessment exercise there are some severe post mortems on departments which slip down as a consequence. Having said that, I think that a function of all universities is to try to encourage and nurture very able young people regardless of their discipline. We cannot forecast at age 23 what will be the hot subject at age 43 when those people are reaching their peak.

(*Dr Booth*) It is clearly of importance in expensive areas of science that concentration has to take place because the country cannot afford to have expensive science going on in all centres. But I think that there may be some subjects—which may apply more outside science than inside it—that are not particularly expensive and where concentration is not therefore so necessary. Because the new universities have not previously been in receipt of dual funding they have shown that they are still able to achieve some quite remarkable results. If one looks at the one to five rating scale, quite a lot of those departments scored 4s and 3s. That was with no underpinning. The well-found laboratory did not exist in the new universities. I think it goes to show that over-concentration could be damaging and could prevent useful science from taking place in universities like mine. I believe that it is a very difficult balance to strike.

(*Professor Davies*) It is a very difficult question. It is interesting to look back at the effects of the removal of the binary line. Prior to that there is no doubt that the variation in funding per staff in university departments was not great for research. If one takes the teaching component, it was surprisingly little on the whole. It varied by only about 40 per cent between the strongest and weakest department. To just take that and smear it over double the number of institutions was clearly untenable, so the only solution was selectivity. I think that it has produced some quite good effects. I see departments that have benefited and suffered from it, but I am a supporter of selectivity. I think it is important to realise that this has happened at a time when the whole system is benefiting from the growth of teaching. If that had not happened I think that the system would have broken down. Because departments had additional money coming in because of the growth of teaching they were able to restructure programmes in a way which otherwise would have been impossible. The fact that we are coming to the end of that process is important because we can no longer rely on this to aid the process of change.

(*Sir David Smith*) I would not want the Sub-Committee to think that I believe the big universities should hog the lot. What I hope that my funding council will encourage is collaboration between geographically close institutions. At the moment, we are forced to be rather competitive with each other but where my university can collaborate it does so with Glasgow and others and that is very successful. But one has to remove the old competition. This is the way in which the new universities can begin to develop a research tradition if it is made easy to collaborate with the established institutions. At the moment that element is lacking in funding council policy.

641. The funding councils' current methodology would argue against it. It is very likely that both departments will end up with rather poor ratings.

(*Sir David Smith*) Indeed.

Chairman

642. I want to turn to the question of the transfer of £150 million per annum from the higher education funding councils to the research councils. What has been the effect of that on universities? Are you being treated fairly by the research councils?

(*Sir David Smith*) As you may know, my Lord Chairman, there was a report by the university finance officers that pointed out that in the first year research councils had not entirely spent the money in the way that had been assumed. I believe that remedial action is now being carried out. I will give the technical details if the Sub-Committee wishes to have them. As a personal view based on my experience in my university, in terms of the research output I cannot see any net benefits of the transfer. It is a slightly negative benefit. Because in the past year my university had to recover £4 million and this year £8 million from the transfer I have had to put staff full time onto making sure that we get it back. In a sense that means a slight reduction in research output. There is an increase in tensions in the departments. I have yet to see the benefits of the transfer. I am sure that from the point of view of accountability it makes it all nice and neat.

Lord Butterworth

643. At last, after a certain amount of wavering, the Government have come down in favour of the well-found laboratory. Has the transfer to research councils gone too far so that the well-found laboratory is not possible to achieve with the moneys that have been left to you?

(*Sir David Smith*) We have only one year's experience and the well-found laboratory involves equipment that needs to be replaced over a longer period than a year. My current suspicion is that even for a relatively well-funded university like mine it will not enable us to provide in the longer run well-found laboratories. I hate to think of what it does to the new universities such as Dr Booth's.

644. I think it is clear that he does not enjoy a well-found laboratory. I think that for the moment the question is directed to Sir David and Professor Davies.

(*Professor Davies*) I am concerned about it for two reasons. First, the well-found laboratory is a long-term concept. It means an investment in a laboratory, library and academic staff. That was what the money was being used to pay for prior to its transfer. If nothing changed and all the grants went to exactly the same places everything would be in exactly the same position. But things will fluctuate. Grants come and go. What you cannot do is run your laboratory, staff and library up and down like a yo-yo when those things come and go. The second point relates to the fact that some of the money has not come back to us as increased overheads. What has happened in a lot of cases is that the research councils have used the money to give more grants of reduced value. I do not think that it is entirely the fault of the research councils. It is very difficult to apportion blame, but the academics themselves who write the proposals know that they are entitled to claim a larger overhead element due to the transfer. They also sit on the committees that give the grants and know very well that if someone comes up with a cheaper thing and the committee is strapped for cash and by giving away smaller amounts it can fund more research that is what will happen. In some cases it has been difficult to get the academics to put the full direct costs in because they believe they will do better by not doing it.

Lord Porter of Luddenham

645. We have heard some rather depressing figures. We have heard evidence about the difficulties that universities are having in attracting students into chemistry, physics and to some extent mathematics. If that is also your experience, do you attribute it to any extent to funding difficulties and subject difficulties in the universities—lack of freedom or whatever?

(*Sir David Smith*) I attribute difficulties in recruitment more to the progressive decline in the perception of the career possibilities. I think that there is much that is good in the White Paper. I regret the absence of an attempt to come face to face with the problem of how to construct proper careers for contract research workers in universities. This is becoming more and more well known amongst students. I put this together with the publicity over the years about poor salary levels. From my experience of the research with which I was associated in relation to the Royal Society and in other ways, I do not think that money counts as a top priority to get people into science, but at least they ought to be able to earn a salary that allows them to buy a house with a mortgage. That is the standard that I would use. I do not think we will get a proper career structure until the research councils and universities collaborate. At the moment research councils provide the money and then say it is the responsibility of university departments. As a personal view, not a CVCP view, at least a significant cohort ought to be jointly funded between universities and research councils. In order that the research councils can expect these people to teach, they ought to be given proper training and be allowed to undertake an extra year to complete the research. Likewise, if people go to the post-doctoral stage there should be a similar recognition. People should not be allowed to do a second post-doctoral unless some potential post can be identified somewhere within the university system. We need something of that kind.

646. You are saying that perhaps it is the career structure which is the worst factor?

(*Dr Booth*) I believe that there is a real problem here because of the increased reliance that universities have had to place on short-term money as to how, given that reliance, long-term career prospects for young researchers can be constructed. I think that there is a window of opportunity about to open up because we know that the age structure of university staff in general is now very skewed towards people in their forties and fifties. It ought to be possible to do a bit of medium-term planning and open up to young people career prospects that take account of the fact that over the next 10 years a very large number of people will be retiring from universities. But it needs someone to take that long view. I suspect that it is a role for government or funding councils rather than individual universities. It is rather difficult for us to grasp that nettle.

Chairman

647. Is it a problem of funding long-term employment out of short-term funding?

(*Dr Booth*) Yes.

648. Are there no precedents within the university sector where just that has been achieved?

(*Sir David Smith*) The more we are expected to account in detail for our expenditure the more difficult it becomes to generate funds to keep such people in post and give them some career prospects. One is more and more driven to what can be given by way of grant, further grants and so on. That is why I believe that one of the advantages of a larger grouping in research is that it gives the manager of the group more flexibility to keep a good person in and try to create a career for him.

(*Professor Davies*) I think the earlier point about the transfer of the £150 million is not unconnected with the present question. One is very much tied to one's research money coming in in the form of specific grants and contracts with identified people and identified periods. Where does the money come from to bridge salaries across from one grant to another? As the thing becomes much more constrained there is less money for such flexibility. There are one or two areas where we are able to handle this problem to a limited extent. I refer to the situation where one has a big team, perhaps of 30 or 40 people. On that scale one probably has sufficient flexibility to have some funding that carries people across between contracts. If one has a group that has two research students and two RAs and the funding for one of the RAs goes, the chance of being able to do anything further is very slim. The problem is a very difficult one.

649. Is it a problem that is likely to be even more severe in the newer universities without a research tradition?

(*Dr Booth*) Yes. The description given by Professor Davies of smallish research teams and their inability to plan long term is bound to apply to us because on the whole the small teams characterise the sort of provision we are making at present.

650. We touched briefly on the White Paper. I think Sir David said that with the exception of the failure to deal with long-term employment opportunities it was regarded reasonably favourably. Would you like to elaborate on how you see the universities contributing effectively and being sufficiently consulted within the co-ordinating committee that is talked about in the White Paper? Indeed, what other opportunities do you see in the White Paper for universities?

(*Sir David Smith*) It is difficult for me to answer the first part of the question without knowing the composition of the co-ordinating committee. If I may go one stage back, at the moment I begin to be concerned about the linkage between the research councils and funding councils. That linkage is not easily visible to me as head of a research university. I think that universities contribute more to wealth creation than might be believed from the statements of certain politicians. That is certainly true at what I call the grass roots level. Quite a lot of my staff—I am sure it is even more so in Professor Davies' institution—who do the work become surprisingly entrepreneurial and look for applications. What I do not yet know in relation to the White Paper is how grants committees will interpret the wealth creation possibilities of the grant, or what directives will be given in relation to it. I would not want you to think that I wholly support the White Paper. There is one area of the White Paper which is a little naive, although I understand its reasoning. I refer to the recommendations to reduce the number of PhD students and add an extra MSc year. You have probably had evidence from the research councils who are now minority suppliers of PhDs. They are the only ones who can operate that. We recruit postgraduates overseas. They will not be very willing to pay an extra year of research fees. I am sure that some universities will accommodate them on three-year PhDs. I do not think that that area has been well worked out in the White Paper. Another area for regret is that there is no suggestion for a humanities research council. To get back to the question of co-ordination, I am afraid that it will depend on how the co-ordinating committee is composed. I sincerely hope that it has sensible representation through one route or another of people who understand the large-scale management of research in universities.

Lord Butterworth

651. Referring to the question of linkage, do you think there will be problems in future because the research councils have a national basis? If the Scot will forgive me for saying so, the funding councils operate on a regional basis, if that is the right expression.

(*Sir David Smith*) As a Welshman living in Scotland but having been educated in England perhaps I may say that it is the substantial if not unanimous view of the Scottish institutions that they very much want to be part of a United Kingdom-based research council system. Scotland has a population of only between five and six million. It cannot possibly cover the scope of research done in Scotland simply on a Scottish-based research council. It cannot assess the whole range of research that we do. We very much want to be part of a national system. Having said that, I am still concerned at the linkage between the research councils and funding councils which it seems to me is not currently provided for, nor can it easily be discovered from the White Paper.

(*Professor Davies*) I agree with that. One hopes that the new Director General of Research Councils will sit on the English funding council. Would the same individual sit on the other funding councils? If not, who would? I can see some basic problem in doing that. Until we know a little more about what the committee will be and its composition it is difficult to see what will happen. The very fact that one system runs on a national basis and the other on a three-country system makes for problems.

652. Have you a message for the new Director General of the Research Councils?

(*Sir David Smith*) I can see the route by which a new Director General of Research Councils will elaborate a general policy for university sector research. I am not quite clear how he sees that operating through the funding councils at the moment. As I understand it, at least some research councils now examine corporate plans and mission

[Lord Butterworth *contd.*]

statements of individual universities and deal with individual universities. I am not aware of research councils going to a funding council and explaining their funds.

Baroness Perry of Southwark

653. Is there not a much more important way in which the two roles interact at institutional level, that is, that if the research councils in considering bids from designated centres, or whatever, follow slavishly the peer assessment done by the funding councils, the two may almost create a frozen position? In your earlier remarks you talked about the importance of developing young researchers. One of the ways that we have been able to fund them in higher education is through research council money, as opposed to funding council money. If the research councils are to behave slavishly and say that all their money will go into grade 5 and grade 4 departments that opportunity will be lost?

(*Sir David Smith*) Perhaps I have oversimplified the problem. If I think of my university with a research spend in excess of £40 million a year, of which only about £15 million comes from the research councils, quite a chunk from charities, from the EC, the Government and from contract, somewhere along the line somebody needs to take a strategic look at it. That is the job of the funding councils. I am not sure whether or not they will do it.

Chairman] We have kept you long enough. We are most grateful for your assistance.

Footnote by Professor Davies to Q. 644.

If academics do not apply for all the direct staff costs they do not attract the full indirect costs which are now paid automatically by the Research Councils at the standard rate of 40 per cent of the total direct staff costs.

WEDNESDAY 30 JUNE 1993

Present:

Butterworth, L.	Perry of Southwark, B.
Dainton, L.	Porter of Luddenham, L.
Dean of Beswick, L.	Selborne, of E.
Flowers, L. (Chairman)	

Memorandum from the Royal Society

1. INTRODUCTION

The Royal Society is pleased to submit evidence to the Inquiry into Setting Priorities for the Science Base. The following evidence, which has been endorsed by the Society's Council, was prepared by an *ad hoc* group under Professor J. H. Horlock. Other members of the group were Professor G. E. Kalmus, Professor J. R. Quayle and Dr. J. J. Skehel.

The Royal Society has broadly welcomed the proposals in the Government White Paper *Realising Our Potential,* and believes it offers a promising framework for the future development of Science and Technology in this country. The Society is pleased to note that many of the ideas put forward in its submission to the Office of Science and Technology have been incorporated into the White Paper; some are re-emphasised here, in this response to the Select Committee's inquiry into Setting Priorities.

2. SUMMARY

The Royal Society accepts the importance of all the issues raised in the invitation to submit comments. It is especially concerned with the following:

— that sufficient quality scientists are attracted into, and retained within, the Science Base;

— that priority setting allows for adequate support for fundamental science;

— that the importance of international cooperation and collaboration is stressed.

The Society made comprehensive statements on funding and organization in the report of its Science Inquiry *The Future of the Science Base* and in its submission on the Office of Science and Technology. The main thrust of the Government's subsequent White Paper was to improve the ways in which Science and Technology in this country can be put to the best use in the broad national interest. The Royal Society supports this general objective and hopes that efforts and expenditure from the public sector will be matched by adequate responses from the private sector.

Here, we make some observations of direct relevance to the current Inquiry and comment on the implications of recent changes in the way funds are allocated. We concentrate on the following topics.

(A.) Setting Priorities.

(B.) "People"—A range of issues are raised in Chapter III of *The Future of the Science Base*. Those most relevant to the Inquiry are highlighted below.

(C.) Matters affecting the universities.

(D.) Comments on Funding and Organization especially: (i) HEFCs; (ii) HEFC/Research Council transfers; and (iii) opening up bidding for RC funds.

(E.) International aspects.

A. SETTING PRIORITIES

We understand the Science Base to include scientific and technological research within higher education institutions (HEIs) and research institutes, facilities and other activities supported by Research Councils, the Royal Society and the Royal Academy of Engineering. It includes research carried out in these Science Base bodies but funded by sources other than the Department for Education and the Office of Science and Technology eg, the medical research charities.

In the past ACOST has provided advice on strategic scientific issues and ABRC has advised on the distribution of the science vote between the Research Councils, the Society and the Academy, but (with the publication of the Government White Paper) both advisory bodies now disappear. The new advisory structure, with a clearer separation between internal and external sources of advice, is in line with Royal Society views and the recognition of the potential role of the National Academies Policy Advisory Group is encouraging. The new Research Councils are required to pursue their various missions, but they also must adopt an **enlightened long-term policy** of supporting our best scientists with the **minimum of constraint and direction.**

Science has a responsibility to society and ultimately society decides what scientists can and cannot do; not least because the Science Base is funded primarily from public sources. Before priorities are agreed it must be clear what the objectives of the Science Base are. **Within these constraints, and within the new structures we believe that scientists and engineers should play a major role in setting priorities.**

The Science Base has a number of objectives which include wealth creation, the advancement of knowledge through excellence and originality in research, creation and dissemination of skills, and the general enrichment of the quality of life and culture that science provides. In setting priorities, while the first of these is important, as the OST paper emphasises, the others must also be considered.

Further, the various objectives are interdependent and cannot be approached as if they could be achieved one by one. The role of the Science Base in wealth creation for example is not simple and linear: it is a complex iterative process that is influenced by many different factors.

There is therefore a need for more strategic and explicit thought about priority setting. Mechanisms for determining and implementing priorities for the Science Base must take note of *all* its objectives. It is also important to appreciate that **time can enter into priority setting as an extra dimension.** Research programmes in the more expensive fields of science can be undertaken and concluded over longer periods of time. Those who supply funds to the Science Base must obviously be able to influence priorities, but not solely, for the practitioners of scientific research have a role.

Over the last decade the sourcing of Science Base funding has changed markedly with substantial increase in funding from non-public sources. We welcome such external funding which demonstrates the value of university research to a variety of customers. The trend towards external funding can go some way further without harming the Science Base. Industry should be encourged by all means to increase its investment in Research and Development, and not rely on public funds as a substitute. However, such industrial funding of Science Base research is inherently vulnerable to fluctuations in the economic situation. Moreover, the further the external work is from the broad mission of the Science Base, the greater the risk that it will distort that mission in ways that individual Science Base institutions will be unable or unwilling to resist. Therefore Science Base institutions must have a clear sense of purpose when undertaking externally funded research.

B. PEOPLE

From the national point of view, in order to meet future challenges **one of the main priorities must be to allow as many well-qualified graduates to undertake postgraduate work as possible** (within the constraints of what the UK can adequately afford to support), in order to maintain the Science Base and the nation's scientific capacity. Particularly welcome in the White Paper is the emphasis given to the **role of the individual scientist** and the need for the **proper management of careers.** The position of women merits particular consideration.

Changes in primary and secondary education, increasing numbers in higher education and a trend to broader first degree courses will radically alter the nature and scale of postgraduate provision. Comparison and competition with Europe both educationally and technologically, is also likely to have an influence on such provision, as is the long-term pressure arising from increased sophistication in science and technology.

Postgraduate work meets many different purposes. It may serve:

- as a professional training for a subsequent career in science or industry;
- as a selection process to help identify the research scientists of the future;
- as an extension of the first degree leading on to a wide variety of careers which may include some not entirely scientific but where a science background is valuable;
- as a research or educational resource, providing assistance to research or teaching staff.

With an increase in numbers and a range of standards reached in first degrees, **there needs to be greater diversity and flexibility in the nature of postgraduate work and of its funding.**

We realise that examination of career patterns is not within the remit of Sub-Committee 1 but we wish to emphasise that **if the Science Base is to be maintained and, we would hope, strengthened, it must attract sufficient people with a real aptitude for research, to make contributions at all levels.** We include amongst these not only those who will develop as independent research scientists and engineers but also technicians and research officers who may form the core of and give continuity to research groups. To achieve this the Science Base must offer conditions of service and prospects competitive with other sectors.

We comment in detail on these matters involving people in the Science Base in *The Future of the Science Base*. But here we would only wish to emphasise a major point made in that report—the need for some shift in emphasis from support of projects to more support for people, especially for younger scientists, to encourage competition, individual expression, flexibility and mobility.

C. MATTERS AFFECTING THE UNIVERSITIES

The universities continue to go through dramatic changes which considerably affect the way they are able to set their own priorities.

The removal of the binary line has left an increased number of institutions bidding for the same amount of "research funding" from the UFC/HEFCs. Some of the new universities stand to gain from this, whilst there will be losers amongst the established universities. This expansion of the number of universities, coupled with the latest research selectivity exercise (which allocates the major part of research funding solely on quality-based criteria), means that there will be a concentration of research in some institutions and a contraction in others. University departments given the lowest grade under the exercise will be credited with little or no research funding.

In its response to the 1987 ABRC publication *A Strategy for the Science Base* the Royal Society opposed the proposal to classify universities into three types R, T and X but recognised that because of pressure on resources some concentration was required. We have now reached the stage of having "R, T X" graded university **departments** but it is still for the universities to decide in which of their departments and to what extent they supply research support from HEFC funds (see also below). Many departments may be able to gain external funding from research, "service" and consultancy activities, but, inevitably, in others research will be in danger of disappearing altogether. The success of departments and the policy of the institution will therefore determine the nature of the university as predominantly research or predominantly teaching. Departments may evolve in either direction and the complexion of the university may change. We hope that the fear of further intervention of the HEFCs in this process is unfounded and that external assessment of either teaching or research remains concerned only with the quality of results.

It is to the advantage of the Science Base as a whole that much fundamental research should be conducted in institutions that are also active in undergraduate and/or postgraduate teaching. Both the teaching and the research benefit. We feel that all undergraduate teaching must at least be informed by acquaintance with recent research findings (ie scholarship) and that it will benefit by being conducted at least in part by staff actively engaged in research and in the development of their professions. We also have a strong view that most postgraduate teaching *should* and all supervision of postgraduate research *must* be carried out by staff active in research.

The Research Councils now have to meet all the costs of the projects they sponsor (with the exception of costs of permanent academic staff and premises) including costs such as research technicians for which previously they did not always pay. As a result of the transfer of the £150,000,000 from the UFC to the Research Councils and the Society (to be allocated now to meet full project costs), universities have less control over their priorities. In addition to financing the "well-found laboratory" these (originally UFC) funds were in the past available to start up new projects and perhaps follow up unorthodox ideas which were not at a stage where they could expect to attract Research Council or other funding. This means that universities are less able to innovate and that is a cause for concern. The Royal Society's small research grants (which were increased by £240,000 as part of the transfer of funds) are an important response to this need. People may be supported in the early stages of their work, often by supplementing an institution's investment.

In spite of this shift of resources, universities are still able to set their own priorities between departments and between teaching and research by deciding how to allocate their block grant within their own institution (although increasing teaching loads and institutions' obligation to meet their teaching commitments first make this increasingly difficult). It is important that this freedom of priority setting continues. The suggestion that teaching and research components might be accounted for separately should be resisted. Having to receive from and account for funds to both the DfE and the OST would be a retrograde, bureaucratic step.

The comments above seek to emphasise the importance we attach to the continuing ability of universities to set their own priorities within their own institutions. That ability has been eroded and we are concerned that the process of erosion should now cease.

D. COMMENTS ON FUNDING AND ORGANISATION

It is reassuring to learn from the OST paper that **two key features** of the present funding system are to be preserved. The Society thoroughly approves of the decision to maintain the **dual support system** for universities in its present form, with two channels of funding for research. Equally important and welcome is the decision **not to separate basic from applied research** but to give each Research Council total responsibility for all the basic research that underpins its general objectives.

Generally we believe that a variety of institutions offering different forms of research support is valuable and this pattern should continue. The nature of the research, the resources and personnel required, will influence whether it is carried out in a university department, a "unit" or a Research Council Institute; each type has its own merit.

(i) *HEFCs*

We are concerned that the regional nature of the HEFCs should not be reflected in Research Council funding. Research funding must follow talented individuals or a concentration of skills; it should not be influenced by geographical quotas.

(ii) *HEFCs/Research Council Transfer*

Further to the points already raised about the transfer of HEFCs' funds to the Research Councils there is some concern that universities may not be claiming from the Research Councils the full costs of projects for which they are funded and this has allowed the RCs to fund an increased number of projects, which consequently are less well supported. We are concerned that, if true, this may lead to a decline in quality of research unless the situation is closely monitored. The universities have a responsibility to claim what they are entitled to and members of peer review committees have a responsibility to help ensure that transferred funds are used for the intended purpose—meeting the full (necessary) costs of projects funded.

(iii) *Opening Up Bidding For Research Council Funds*

We are concerned about any suggestion that Research Councils' grants could be made available to any bidder. This is a dubious application of the principle of competitiveness. The responsibility of Research Councils in giving grants is to support the research and training functions of the Science Base, not to "buy" specific pieces of knowledge. The idea of a "free market" in grants, open to all types of organisation is therefore misplaced—a conceptual confusion between grants and contracts. However, there might be a case for bodies within the normal definition of the Science Base, or even on occasion other public sector grant-aided bodies, competing for grants from the Research Councils, provided they do so in a way that does not discriminate against the long-term national interest. This implies, *inter alia,* that proposals must be priced realistically and not be subsidised from funds intended for other purposes.

E. INTERNATIONAL ASPECTS

Finally we would like to comment on the international nature of scientific research.

As far as international projects are concerned, **it is obviously best to place the work where it will be done most effectively and efficiently. However, for UK science to derive maximum benefit from European collaboration its representation must be as strong as its partners and the national position must be emphasised** in order for UK interests to be properly reflected in European priorities. Recently there appears to be a greater will on behalf of government to promote the UK view, as evidenced by the submission to Framework IV prepared by the OST.

The opportunities for UK scientists overseas and the advantages of attracting facilities and foreign scientists to the UK must be recognised. **The strength of the UK Science Base is enhanced by greater international collaboration and mobility** (see the Royal Society's Corporate Plan). **Funding for this purpose must be recognised as of high priority within any "priority setting" exercise.**

In our evidence to the Select Committee on Science and Technology Inquiry into International Scientific Programmes we commented on the procedural vacuum in the UK for assessing declared international programmes. This appears still to be the case. A single mechanism should be established to enable the UK Government to decide promptly and in the light of national priorities whether participation is desirable and which agency should take the lead.

Furthermore a mechanism is required to consider the siting of international facilities on UK soil. We believe there are advantages to hosting appropriate facilities in terms of prestige, access, development of expertise and improving morale (through demonstration of excellence by a British run institution). In addition there would appear to be economic advantages; these are examined in a recent OST publication *Economic Impacts of Hosting International Scientific Facilities*. We welcome the recent UK success in attracting the European Bioinformatics Institute to Cambridge.

Examination of witnesses

SIR MICHAEL ATIYAH, OM, PRS, PROFESSOR J H HORLOCK FENG FRS, Treasurer and MR A J LEANEY, Science Policy Advice Section, Royal Society, were called in and examined.

Chairman

654. Sir Michael, thank you and your colleagues for joining us today. May I ask you to say something about what you consider to be the strong points of the White Paper and also the weak points of it, and what messages you would like to give to the new Director-General of the Research Councils, whoever he or she is.

(*Sir Michael Atiyah*) Thank you, my Lord Chairman. The White Paper is very much in our minds and while we welcome it, in general terms, I think there are some aspects of it which cause us

[Chairman *contd.*]

concern. A lot will depend on how it is interpreted and that, in turn, will depend upon the key people who are appointed to carry out the implementation. As far as identifying the strong points of the White Paper, I think the one we would particularly welcome is the fact that basic research and applied research have not been separated. There were alternative schemes put forward that one should do this, we argued against those, and we are glad that that advice has been followed. Therefore, each of the new Councils has a mission and within that mission it is supposed to support the basic research underpinning all its subsequent activities. We thought that was an excellent principle to adopt and that is a very strong aspect of the White Paper. The weak points are that there are some specific questions about the organisation of a separate Research Councils and where the boundaries are going to be drawn—the exercise that David Phillips is conducting—and, in particular, many of my colleagues are worried about the position of chemistry, where it fits uneasily between the new frontiers—but I hope that appropriate care will be taken in setting up these new frontiers. Another point which we were a bit disappointed about was that one of the main functions of the OST when it was established, was, of course, the oversight of Government science and technology across all departments. The White Paper is now supposed to set up a framework to see how that is going to be carried out. We are not convinced that that framework is maybe strong enough yet to carry out this function. In our own submission, at an earlier stage, we did suggest ways in which it could be strengthened by some financial reallocations that would give it a bit of clout. Those were not adopted and the framework is as now, but it is still not clear to us how the OST is going to carry out this very important function. That remains to be done and that is one of its major tasks. That depends very much on the people involved and how they are going to carry out across-the-board implementation. I suppose the one thing about the White Paper that concerns us most—and this may, perhaps, be a separate question—is that the emphasis on wealth creation, as a whole, is one which we, in principle, approve of, although I think, perhaps, we would have put broader objectives, and not have made it quite so narrow. However, this is our view. I think it could be misinterpreted if applied in a negative way, and we are worried about how that is going to be carried out. If the view is that one wants to see a better match of science and industry in this country, and a better way of conveying science into applications, we are all in favour of it. But if it turns into some very rigid way into which to direct the future of science in the light of particular industrial requirements, then we think it would be very dangerous. So those are our broad initial reactions to it. You ask, specifically, about advice to the new Director-General. That is difficult. I think that is going to be a very crucial role. Much will depend on the person involved, who he is, what his background is and how he sees his task. Clearly, his primary task is to advise and see about the respective allocations and resources as between the separate Research Councils. That is a very difficult task. I do not think, at this stage, that I would like to hazard advice to the individual, until we see who the individual is.

(*Professor Horlock*) Perhaps I could bring out, my Lord Chairman, one or two points in our submission, in answering the question. I think that on the first page we emphasise that we wish to be sure that there are sufficient quality scientists coming in, and we think this is an important point within priority setting. As the President has said, we think that the priority setting must allow for adequate support of fundamental science and I would amplify that by saying that basic science is within basic science and engineering, as a whole. We are emphasising that it is the basic work that is important within both pure and applied. We would emphasise also, that we feel that scientists and engineers should play a major role in science in the priority setting. We accept that overall funding from public sources has to be set by Government, but we would wish to see scientists and engineers work within that constraint and playing a major role. We would suggest another point here, that time can enter into priority setting as an extra dimension, and that this should be taken into account in large-scale projects. I think the main message we wanted to get over, my Lord Chairman, is this question of people. The Royal Society is very much concerned with people, and with selecting high-quality people, and we would feel that one of the most important things must be to make sure that there are enough well-qualified graduates coming through to post-graduate work. We think that is important. We have listed post-graduate work, in fact, and the different aspects of post-graduate work in the submission. I will not go into those but we feel with the White Paper, the Waldegrave Paper, that there should be greater diversity and flexibility in the nature of post-graduate work and its funding, particularly of people. So we cannot emphasise enough, I think, that we must be sure that we are attracting sufficient good people into the science base to do the work. We listed a number of points related to the universities, but you may wish to pick these up later on.

Lord Dainton

655. I notice that you welcome the extension of the PhD course to four years, the first year being of a different kind from the rest of it. That means that, with the restrictions on money that now exist, there will be a diminution by 25 per cent of those who enter each year and leave each year. Does that give you cause for concern? Do you think the present numbers excessive and should they be reduced by that amount, as a fraction of the original number?

(*Professor Horlock*) I would not go along with that statement, but I think that I would make two points. One is that the White Paper is specific, I think, about more Masters' courses, essentially. We would go along with the idea that the Masters courses are important as an introduction to the three year PhD. I think in looking at that one must also look at what is going on in higher education first degrees as well, because some of the three year courses have been extended to four years. My old Department at Cambridge now is offering a four year course to the first degree. Those people may not need the Masters

[Lord Dainton *contd.*]

course as well before going on to the PhD. It does seem to me we have got to look at the two things together in parallel—the first degree and postgraduate work.

656. It depends critically upon whether support for that first four years, however it is described, comes from local authority grants plus loans or whether it comes from the Research Council budget. Have you any information on that at present? That does seem to me to be absolutely critical.

(*Sir Michael Atiyah*) I recognise there are these different financial sources of funding. I feel it is unfortunate that we have to decide on what are essentially educational/academic issues while these are administrative findings. There is a strong case for having three years extended to four, whether that is a four year undergraduate course or whether it is the first three years plus a postgraduate which are educationally and academically essentially almost equivalent. It is unfortunate that we get tied up with these administrative financial wrangles about who pays. I realise these are practical problems for Vice Chancellors, but looked at objectively I do not see a great deal of difference. I would just add to what the Treasurer said, that I think it is important whatever is adopted here is not adopted as any kind of Draconian uniform rule. We have a large diversity of institutions, courses and people, and any attempt to have a rigid system would be a mistake. We want to have flexibility in the system, and some move in the direction of more formalised Masters courses is perfectly acceptable, but I would be very much against any kind of diktat from the Department for Education.

Chairman

657. You want suitable preparation for the PhD no matter where it comes from?

(*Sir Michael Atiyah*) Absolutely. It exists at present in various headings. We would like to see evolution from the present.

Lord Dainton

658. One point which has been made in my particular subject, or my former subject I should say as a chemist, is that a great weight of their research is carried out largely by research students, and they are alarmed by the diminution of numbers. Has that concern come through to the Royal Society?

(*Professor Horlock*) We are getting the message, I think.

659. I do not think it is unique in that respect, it is just that representation has been made to me.

(*Sir Michael Atiyah*) I think it is specifically noticeable in areas such as chemistry where there is a very close relationship between the research students and the supervisor. I think, on the other hand, looked at from a general point of view from the Royal Society, we have to say that one should look at research students and their educational needs from the point of view of the individual, and not from the point of view of him being a pair of hands to assist the supervisor. I think that is the wrong end of the stick. I think the priority should come the other way round.

Chairman

660. May I ask you to explain your own rules as a funding agency, especially how you determine priorities for choosing different types of people to support?

(*Sir Michael Atiyah*) I think the answer to that is reasonably clear, because our support is almost entirely towards individual people through fellowships and small grants, and we do not distinguish between subjects. We take everybody on straight competition, on merit. We do not allocate quotas to subjects, except in a very broad way. Administratively we divide the physical and biological sciences for rough convenience. I think that is right in dealing with high quality individuals whom we select and support. That is not to say a larger organisation, such as the Research Councils, should operate in the same way. We are a small funding body. We fund people, rather high quality people, on an individual level, and at that level I think it is quite right that we target the individual and respond to the applicants that come forward as best we can irrespective of the fields in which they are. We find at the end of the day that they spread out quite widely. We do not end up with all people doing nuclear physics, if we did then we would be worried. Other than having an introspective look at what you do, I do not feel there is any need for us to specify in advance the areas we think we should specifically support.

661. May I hear your views about whether it is possible to equate an excellent astronomer with an excellent microbiologist?

(*Sir Michael Atiyah*) No mathematical equation is possible of that kind. We try to adopt a uniform comparison in the sense that we measure all scientists by the highest international standards. We do try to ensure that when we compare people we are getting the best international advice we can. By the international standards of the various fields we think we put people in the same sort of place. There is no possibility of making an exact comparison between people in different fields. It is a difficult task and we do our best.

Lord Porter of Luddenham

662. On the last point, the point has been made to us by the Research Councils, when we asked them how they choose between these subjects, which is such a difficult job, and the real answer is that it is historical essentially. That is how things are and that is how they have stuck. Is that different with the Royal Society? You have the nine sections still; do they change much with the changing face of science, because surely the face of science is changing?

(*Sir Michael Atiyah*) I think there are two different things slightly entangled there. The Royal Society sectional committees which Lord Porter refers to are a division which we operate for the purpose of electing our new Fellows. They are not for the purpose of funding people.

663. The election of Fellows is itself an indication by the highest scientific body in the land of what is the relevant importance of those subjects?

[Lord Porter of Luddenham *contd.*]

(*Sir Michael Atiyah*) Obviously electing a Fellow of the Royal Society is some measure of recognition. It is not funding, but it plays some role I suppose in its influence and responsibility. I agree that within the Royal Society we have historical traditions. I have to say, and I think Lord Porter will recall, that we have in recent years conducted a very radical review, particularly in the biological sciences where there have been very rapid transformations and changes of divisions and we no longer use the same terminology as in the old days, so we try to move with the times as far as we can. If I could answer the first part of the question, which I think related more to Research Councils. The Research Councils, like all other large organisations in government, nearly always work on historical funding principles. You see what you have spent in the last year and see what minor changes you can make this year. I think in bald terms that is a reasonable way of proceeding; otherwise you get drastic discontinuities and nobody can survive, and year to year budgets go up by 20 per cent. It is not true that Research Councils have not changed over the years. Lord Flowers was involved with the SERC to the present time and there have been very significant changes over long periods. I think that is right. I do not think I would advocate radical changes from year to year; that is not a sensible way of proceeding. All our colleagues want some kind of reasonable continuity.

(*Professor Horlock*) One point on research fellowships, my Lord Chairman: having done this round as a new boy, I have done it for the first year appointing Research Fellows and the quality is absolutely staggering. It really is extremely difficult to choose between these 800 candidates to make 30 or 40 awards. One wonders whether one is doing it entirely fairly because they are all so good. On the question of balance, I suppose we do have a broad balance which is roughly between the physical sciences and the biological sciences, perhaps with a slight bias towards the physical sciences. I am tremendously impressed with this scheme and the national contribution that is being made by these 200 people of such high quality. It really is a major impact on British science. The only reservation perhaps I have is as an engineer, that I do not see enough people coming through on the applied sides as candidates for these fellowships, because in general an engineer does not have that kind of career up to that point. He has probably been in industry rather than working as a post-doc for many years.

664. ACOST will see its demise this month, and you have served on it for the last two or three years. I want to ask you, in view of the White Paper and the demise, what you see as the direction of ACOST's successor and replacement? Was there anything wrong with ACOST, and will the new scheme be any different?

(*Sir Michael Atiyah*) There have been, of course, a whole string of Government advisory bodies of this kind over the years and I expect, quite frankly, that maybe expectations have always been too high. I am not quite clear what such a body can really achieve—the aims that one wants. I think my experience of ACOST was fairly limited. I think my criticism of ACOST was that it was trying to do two separate things. It was trying, on the one hand, to take a very, very broad view—the kind of thing which very busy people, who have a lot of experience, can contribute to usefully—but, on the other hand, it was taking very detailed, micro investigations, which I think are not compatible with the kind of people on the Committee. So, for example, I did not have time to attend most of those meetings; therefore, I could not really contribute to them. I was not the right sort of person to be on the sort of body it was. I think there was a confusion of purpose. I imagine that the new body will, perhaps, not conduct the kinds of detailed studies that ACOST did, but farm those out to other bodies. I think there is a reference in the White Paper to that being done, and it will concentrate more on broader issues of a kind to which its membership is more suited. I think that is the intention, but it depends on whom they appoint, how it operates and how it is chaired.

665. You mentioned that a number of people have corresponded with you about the problem of chemistry which falls between the two stools of two separate Research Councils and settles on neither of them, as it is at the moment. You said that you were looking into this. I do not ask what is the answer, but what sorts of changes are possible, in your view, or in the view of yourself and your colleagues at the Royal Society?

(*Sir Michael Atiyah*) My Lord Chairman, I did not quite say that the Royal Society was looking into this, although the operational arm is going to carry this out. I have had letters from our Fellows in this area pointing out the particular problems for chemistry, and I have referred to those. When, of course, the David Phillips Committee has conducted this enquiry as to how to divide the SERC on scientific and resource grounds, and when it has produced its draft report, we will be consulted. At that stage we can input and we will try to look and see what attention needs to be paid to chemistry, and think of different ways in which it can be improved. Since the main structure is, I imagine, now fixed, all we can do is to see how the demarcation is to be carried out and give the best advice we can. I have to say the thing has been conducted, as usual, with great haste. We will have a few days in which to comment on it and I am not too optimistic that we can actually have too much effect.

Baroness Perry of Southwark

666. You said earlier, I think, that you were pleased that the White Paper had clearly delineated what basic research was and that it would be preserved for ever. On the other hand, the mission statements of the Research Councils do have fairly consistent objectives to wealth creation and there will have to be industrial chairmen. Are you concerned that there could be a switch of emphasis within the Research Councils and if there were, where do you look to for preservation of the basic research?

(*Sir Michael Atiyah*) We are worried about the possibilities down that line. Much will depend upon what kind of chairmen they are and what line they take. If they came in and thought their view was to shift substantially the resources within their particular councils, from the basic into the much

[Baroness Perry of Southwark *contd.*]

more applied end and targeted towards particular industries, we think that would be a mistake. How I hope they will interpret their remit is that it is their task to try to match up their particular council's research and industry outside in a variety of ways—by improving the transfer of people and improving the flow of information backwards and forwards, improving collaboration—and, at times, there may be some switch or minor steer of resources that is necessary. For example, I can see that if you are talking about the kind of research which is rather close to the application end, if you were dealing with optical fibre technology, for example, this is very close to what is actually being used outside. So if you had a number of different areas, which were being studied in your council, and some of those areas had a strong industrial area outside in the country which could use that research and others did not, you might then decide that it would be sensible to have a shift of those resources. That, I think, is very much at the top end, where things are very close to the industrial edge. Down at the bottom, where you are talking about the basic science, this underpins all these, but I should not have thought that one would want to make a reallocation. In other words, I see any reallocation of resources, on the part of this mission, as being what one might call a horizontal one, rather than a vertical one; not moving money from the basic end to the applied end, but shifting the way in which different areas of application are funded. That, I would regard, as an intelligent and sensible way of interpreting the White Paper. If the chairmen were to adopt that view then we would be very happy with it and I think this would be very sensible. If, however, they were to take the other view and their aim was actually to move large amounts of money and decrease the amount of basic science, with the aim of boosting the very applied end, that I think would be a mistake for a lot of reasons. First of all, I think we have to recall that the amount of science, funded and supported by the Government, is only a very small fraction and by far the biggest proportion is conducted outside in other Government departments and industry. This rather small fraction is a part of where much of the basic science is to be done, so in that context it is not a large fraction and to decrease it even more would undermine all the subsequent applications across the board. So I think that would be a great mistake and we would strongly argue against it, if that turns out to be the views of the chairman in charge. I hope the comments that Mr Waldegrave has made in his presentations suggest that he is aware of the problem and he is not interpreting the White Paper in that very deleterious manner. It very much depends on how it is going to be implemented and we will have to watch it very closely.

Chairman

667. I think some of us may have been somewhat alarmed when, earlier on, Sir Mark Richmond came to see us and suggested that his Research Council was considering putting money into good research wherever it was being done, including in industry. As I said, this is the other side of the same coin, perhaps, but it could mean a diminution in the money available for research in universities and Research Council laboratories—therefore, in the science base—and probably slanting money towards application, rather than underlying sciences. Does that thought alarm you?

(*Sir Michael Atiyah*) Yes, it alarms us very much. I think you could argue against any idea that Government money should be used to support research in the industrial world. Part of the reason for Government support of science is to support the institutions in this country and the universities which actually provide the manpower and the research. The whole aim would be vitiated if one were thinking of basic research as something you could contract out to all and sundry, wherever they might be. I think that would be a terrible misapplication and we would strongly reinforce the view in the White Paper that the science base is firmly centred in the universities of this country. We would not want to see that changed.

Earl of Selborne

668. I want to refer to your paper in which you have made the point that the practitioners of scientific research have a role in determining priorities. I wonder if the President would like to comment whether there is anything in the White Paper on the proposed structure of the Research Councils which causes concern in this respect, and whether you think the practitioners of scientific research are going to be inhibited in making a contribution towards determining the priorities.

(*Professor Horlock*) I do not think we would say that we are particularly concerned. We are really just saying that those who are active in research should take a view in the priority settings. We would expect to see, as we have seen in the past, distinguished scientists and engineers on the Research Councils and taking part in those decisions. I do not think we would say any more than that.

Lord Dainton

669. Would you go as far as Professor Stewart, who was recently reported as saying that he wants to see very many more young people involved?

(*Professor Horlock*) I would go that far, yes, indeed.

670. I was not quite clear at one point in the statement of the Royal Society where they seek to emphasise the importance attached to the continuing ability of universities to set their own priorities. Would we be right as interpreting that as meaning you do not wish to see at any time in the future any further transfer of funds from the Funding Councils to the Research Councils?

(*Sir Michael Atiyah*) Yes, absolutely.

(*Professor Horlock*) I think we would put it simply: thus far and no further.

Lord Butterworth

671. I wonder if I could quote another sentence from your paper, that research funding must follow talented individuals or a concentration of skills. It should not be influenced by geographical quotas. At this point the English language runs out of suitable

[Lord Butterworth *contd.*]

words. I do not want to offend the Scots in any way, but what is the Royal Society's reaction to the regionalisation of the Funding Councils?

(*Professor Horlock*) I would have thought that we would accept it, but with some regret. We would certainly not wish to see it go any further in terms of the Research Councils. That is the point we were trying to make in the paper.

672. We would all agree here that research funding should be on a national basis. If you have a Regional Funding Council where Glasgow can only be compared with Edinburgh, and Edinburgh with Glasgow, is this the best way to run that sector of funding?

(*Sir Michael Atiyah*) I think one can reasonably differentiate between the university Higher Education Funding Councils and the Research Councils because the universities are the great centre for educational institutions and I think some of them very traditionally have a strong regional role. I think that is something I would like to see strengthened. We have a large number of universities in this country now and I think many of them have strong local links and they should be strengthened as far as possible. In that direction I do not see anything wrong with Scotland, for example, which has a strong identity of its own, using that in a way to enhance its local universities. I think within that context it makes some sense. At the research level it makes perfectly good sense to have them funded on a United Kingdom basis because that way you maintain comparative standards at the highest level among the research to be conducted. Given that universities are very complex bodies which have a variety of roles all the way from the educational role and the links with the local community up to international quality research, I think it is reasonable that you can marry the two together. It is not entirely unjustifiable and I think we can live with that.

Chairman

673. The Chief Scientific Adviser in the future is going to have a co-ordinating committee between the Research Councils and the HEFCs. What useful role do you see for that body?

(*Sir Michael Atiyah*) We strongly support the dual support system, in which the Higher Education Funding Councils provide the basic infrastructure for research and the Research Councils top that up with project money for particular areas. Since it is a kind of cross-patch there it is pretty essential that somebody keeps an eye on how those two things fit together. There is not much point in Research Councils handing out money if there is no infrastructure to hold it up. There is no point in laying down infrastructure if nobody puts any money in to keep it going. There ought to be some matching between those two sources of support, and a committee ought to be able to keep an eye on that. It does not need to be directive in any way. It need not make fundamental decisions of policy but ought to keep an eye on how things are going and draw attention to any serious mis-alignments. I think that is a very reasonable role for it to perform. Given that you have a dual funding system, something like that seems to be necessary.

(*Professor Horlock*) I would only add that I think it has a role in relation to careers of scientists as well, for people who are working on Research Council grants and perhaps moving into university posts at a later time. I would hope that the Royal Society might be involved in this as well. We have a role in career planning through these university research fellowships that we have been talking about.

674. I wonder whether we could turn to the wealth creation aspect of the White Paper. Do you have real expectations of the Technology Foresight idea? The concept of partnership with industry is really quite extraordinary in a White Paper coming from this government, where a partnership and contact with industry has been taboo for a very long time. If it is genuine on the government's part, it seems to me that those who believe in it ought to be ready to do something about it. The Technology Foresight programme is one bit of machinery for doing something about it. If I may ask you more broadly, if you are convinced it is a good thing, what do you propose to do to assist the partnership in industry?

(*Professor Horlock*) First of all, in relation to the Technology Foresight programme I would echo what Sir Geoffery Allen said to you, "Fine, but don't expect too much of it", because it is a very difficult area to deal with. I think of two industrial activities I am concerned with, one is power production—there has been a tremendous shift in power production in this country from coal-fired power stations to gas-fired over the last two or three years. I do not think the Technology Foresight group could have anticipated that. There were two things which happened: one was freeing gas use for power production by the European Community, and the other was the privatisation of the electricity industry. With a big decision like that I would be very hesitant about a Technology Foresight committee predicting that. If I think about the other industry I am concerned with, which is the aircraft engine industry, I cannot see a Technology Foresight group saying what engine Rolls-Royce should be building in ten years' time. It might say, as Geoffrey said to you I think, that this country should be in the aircraft engine business, but it cannot go too far in the selection of projects. I would caution just a little bit of wariness in relation to the big project predictions. I think the other point I would pick up is the attitude of industrial companies. I would refer to the *Financial Times* the other day which drew a contrast between German industry, which not only looks at the dividends immediately for shareholders but looks at the long term and research and development and I would wish to see British industrial companies moving in that direction. I would hope to see government influencing companies towards that kind of attitude. How, I am not sure, but perhaps the Treasury could advise rather than me. That is the route I would like to see.

675. I had taken the Technology Foresight concept as a piece of machinery for trying to help with the determination of what the strategic areas of research might be. Perhaps it has other functions too, but surely that should be one of its functions?

[Chairman *contd.*]

(*Sir Michael Atiyah*) I understood that what the White Paper said about that was, yes, that is its broad objective.

676. That rather than projects?

(*Sir Michael Atiyah*) Yes, but it recognises it is rather difficult to do that. It ended up by saying that the process was more important than the ultimate aim. The process of getting people together from industry, government and universities to discuss the way science was going, the possible application of what it could do, that brings people together on an ongoing basis was itself a very useful exercise. Whether, at the end of the day, it would come up with some grand statement saying that this is what is going to happen, let us put money in this, that is much more doubtful. I think I would go along with that. Decisions are made by different people in the country, no government takes all the decisions; there are lots of separate decisions being taken by industry and elsewhere. If you have an involvement of people exchanging information and encouraging them to collaborate in various ways, that will actually be an effective way of getting things done. You cannot suddenly decide if you are a Minister that we are going to develop this or that, it has to be done collaboratively with people outside as well. It is a process of discussion which is realistic. Whether it can actually end up with major policy decisions which will be implemented I am more doubtful.

677. One of the problems underlying Britain's economic position is the lack of attention to R&D by industry—many of us agree about that. What can this new regime do to try to change this situation? In particular, what can you do within it?

(*Sir Michael Atiyah*) I think the Treasurer was hinting at the things you can do, which is to try to get British industry to invest more in R and D. Various things have been tried. You can try exhortation but that gets you so far and not much further. You can try education and produce more scientifically-trained manpower and put them into top managerial positions, but that takes generations. We would try more Government involvement in the financial regulatory aspect of trying to make sure investment goes into companies that do invest in R and D on the long-term basis, so the Government has a role to play there. It is not our expertise to advise them how to do it, but other countries do succeed in doing that and we do not. I think that is the one biggest single difference between ourselves and some of our more successful competitors.

(*Professor Horlock*) I think the other thing that might be worthwhile, my Lord Chairman, is to look at those areas where it has been very successful. If one looks at some of the chemical industries, for instance, and the links between the industrial companies and the universities. For example, if one looks at Rolls-Royce and the Whittle Laboratory in Cambridge, where the integration is very close, both groups work as a team. If one can pick out the successful aspects of those successful ventures that would be a way forward.

Lord Porter of Luddenham

678. There would be nothing, first of all, that the Government could do with the companies, or the activities that you have just mentioned. The chemical industry seems to have all the liaison between academia and industry and, presumably, the aero-engine industry too. What you are saying is that, perhaps, the Technology Foresight Programme would, in addition to what Sir Michael has said—which is a very good point because it brings people together—be trying *encourager les autres* to do the same.

(*Professor Horlock*) Absolutely. I think we have some marvellous examples in this country; let us not always be too gloomy about it.

Baroness Perry of Southwark

679. On that point, my Lord Chairman, the Royal Society could play a very useful role in publicising the good examples most specifically to those in the Stock Exchange, because one of the difficulties in persuading British industry to undertake long-term R and D is that they know very well that the City will murder them unless their last quarterly statement shows the right kind of profit. I understand that in Japan, for example, the reverse is true. Unless a company is putting money into long-term R and D the Stock Market in Tokyo will judge them on that basis, and if our industry power-base could be persuaded to think in those terms it would be a very good thing. The Royal Society could have a really useful role to play there.

(*Sir Michael Atiyah*) We will do our best, my Lord Chairman. Our influence in the City is limited but we will try.

Chairman

680. One of the disappointments, to me, in the White Paper was to see the very negative role played by the MoD in its chapter of the White Paper, as if it had been written by somebody else with quite a different aim. I wonder whether you have a view about the role the MoD should be expected to contribute to any national strategy of science and technology.

(*Sir Michael Atiyah*) I think I can answer that in two ways. Certainly, on the one hand, the MoD does conduct a lot of very high-tech. scientific research, obviously for its own purposes, and where possible, that ought to feed out into the civil sector, in a variety of ways, which we would encourage. On the other hand, I am also concerned that there is a large amount of money that goes from the national Budget into the Defence establishment. Government policy is, of course, to try to reduce that, as far as possible, and some of that ought to find its way eventually to alternative areas in the civil sector. There is, of course, a danger that if the MoD tries to justify itself by saying what marvellous things it does outside, we will simply maintain an over-large defence contribution. So I think one has to be a bit careful. The Ministry of Defence has a mission and if its mission is broadened too much, it may upset the right balance between the military and the civil sectors. I think there are dangers.

[Chairman *contd.*]

681. It makes serious inroads into the personnel available—of scientists.

(*Sir Michael Atiyah*) I think one should emphasise that defence uses a large fraction, not just of the money that goes into scientific research, but the top-class people, and that is really more important than the money. As defence is run down—hopefully in a more peaceful era—we hope that some of that scientific expertise will find its way into the wider world outside. That ought to be part of Government policy.

682. Thank you. Are there any other points that you would like to make which we have not asked you about?

(*Professor Horlock*) I think we have covered most of the points that we wished to raise, in the submission.

(*Sir Michael Atiyah*) We have covered everything, thank you.

683. Thank you. Those who are about to take your place at the table, no doubt, will have benefited from hearing this rehearsal!

(*Sir Michael Atiyah*) That is one of the disadvantages of coming first, my Lord Chairman!

Memorandum by the Royal Academy of Engineering

EXECUTIVE SUMMARY

The Royal Academy of Engineering welcomes the opportunity to submit evidence to the Sub-Committee on "Priorities for the Science Base". The relationship between the Science Base and industrial activity is recognised to be of fundamental importance to the future economic well being of this country.

- Public expenditure on the Science Base has the twin objectives of developing cultural values and of assisting the UK economy.
- The Government needs to define its strategy and technological policy objectives in relation to the development of the Science Base.
- This country lacks an overview and the intelligent selection of priorities and strategies when funding science and technology.
- The OST should oversee priorities for R&D in all Government Departments to ensure cohesion in the national programme.
- The Government needs to identify the ways in which other countries set their priorities for the Science Base.
- A professional organisation is required to seek out information and to prepare unbiased reports for consideration by a "priority setting body".
- Good engineering is essential to wealth creation and contributes to the science base but is dependent on a high quality science base for success.
- Publicly funded research expenditure should, as one of two objectives, be targeted to bring economic benefit and help create a healthy economy.
- The imbalance between investment in pure scientific research and useable new technologies which will create wealth for reinvestment must be redressed.
- Attention is drawn to the disparity between the UK's excellent reputation in scientific research and poor industrial performance compared with Japanese industrial strength with their much weaker scientific base.

The Royal Academy of Engineering undertakes the pursuit, encouragement and maintenance of excellence in the whole field of engineering. In order to overcome traditional barriers, the Academy promotes a multi-disciplinary approach to demonstrate the interdependence of different areas of expertise in the effective use of modern technology and engineering. Emphasis is also placed on the importance of well-informed communication between engineers, research establishments, industry, public services and academia.

INTRODUCTION

The Royal Academy of Engineering

1. The Royal Academy of Engineering is the United Kingdom's independent self-governing body of professional engineers of all disciplines. The Academy's objectives are the pursuit, encouragement and maintenance of excellence in the whole field of engineering in order to promote the advancement of the science, art and practice of engineering for the benefit of the public. By recognising Britain's most distinguished engineers the Academy aims to take advantage of their wealth of engineering knowledge and experience. The interdisciplinary character of the Academy's membership provides a unique breadth of engineering experience with which to further all forms of engineering.

2. This evidence represents a collation of views from Fellows of the Royal Academy of Engineering. It cannot reflect the views of all contributing Fellows nor those of the Academy as a whole. It may, however, be regarded as representative.

3. The relationship between the national research programme and industrial activity is recognised to be of fundamental importance. Hence the Academy is interested in seeing publicly funded research expenditure targeted to where the fruits of the research will be of most benefit to the economic well being of the country. In the context of wealth creation, science and technology are not sufficient on their own and should not be accorded singular priority, particularly in the present economic climate. In a world in which competition is becoming fiercer, all investments have to be scrutinised and judgments made to establish a broad portfolio with potential for immediate, short, medium and long term rewards and even, possibly, no foreseeable rewards. However, a prime and essential requisite is a healthy economy.

Observations and comments on Government Policy

4. The Government's policy for the funding of civil science were set out by the then Secretary of State in 1989 and reiterated by the Advisory Board for the Research Councils (ABRC). The objectives include, inter alia, for the good of the UK:
to advance knowledge and technical capability;
to help and achieve economic, social and cultural benefits;
and in collaboration with industry and other Departments

- to move the balance of research towards exploitable areas
- to promote greater common purpose between the Science Base and its users—in industry, commerce and government.

5. The mission of each government department in the context of R&D policy should be defined and co-ordinated. OST should be given the task of overseeing priorities for R&D in all such departments to ensure cohesion in the national programme. Furthermore, the OST should advise the Treasury with the aim of improving the economic model through better representation of the effects of investment in development and the encouragement of innovation. The revised arrangements would facilitate the identification of priorities, the highest of which should be rapid and major improvement of the funding and management of research into industrially relevant technologies and manufacturing and construction processes, to enable industry to develop competitively into the 21st century. The development of technologies, applicable across companies and industries, should not be confused with the design and development of products, which is the task of industry.

The Science Base

6. "Science base" has the broad meaning of "all scientific, technological and engineering research and post-graduate training however funded, conducted at, or in conjunction with universities and research council institutes". This "science base" should provide:

(a) A supply of trained scientists, technologists and engineers, with adequate knowledge and skills in conducting research and investigation;

(b) Repositories of scientific information, not only generated in the institution itself, but from all good quality sources on a wide international basis;

(c) A capacity to carry out basic and applied research relevant to a company's efforts to carry on a successful business.

7. It is very much in a company's own interests to maintain contacts with those institutions in the UK (or indeed elsewhere) which are capable of satisfying one or more of the objectives outlined above. All these objectives, however, can only be achieved through readiness on the part of the institution to focus its efforts on areas which have already been identified as significant to the company's interest, or, equally important, are generally agreed to be of increasing importance in the next decade or two. (An excellent example of the latter is the need to concentrate on many aspects of materials science, including a thorough understanding of the characteristics of the materials relevant to their engineering applications.)

Science, Technology and Engineering

8. Science on its own is not primarily wealth creating. Science requires inquisitiveness and the ability to pursue the simple questions "How?" and "Why?". Increasing knowledge by itself does not provide the financial means for continuing furthering knowledge and understanding. The ability to increase knowledge requires financial investment.

9. Technology is the application of scientific knowledge and engineering techniques to useful benefit. Engineers employ the results of science through the medium of technology.

10. Engineering is about increasing wealth: not simply pecuniary advantage. It requires imagination as it is concerned with design, creation and the ability to see what use can be made of the results of science to

provide a benefit. Good engineering is essential to wealth creation but, in addition to contributing to the science base, is dependent on a high quality science base for economic success.

11 Whilst science, technology and engineering are interdependent they are most certainly not the same or interchangeable. Since much misunderstanding stems from the view that engineering is a branch of science rather than a user of it, there is a need to improve the public understanding of the complementary roles of science, technology and engineering, together with their vital importance to the country's economic future. An information campaign should be targeted at the City, media, company chairmen and chief executives at all levels, in all regions, as well as the educational fraternity at school and university level.

12 The Academy recognises there is a great deal of excellent prestige science in this country. However, it is not matched by sufficient useable technology to underpin engineering and industrial developments, innovation and wealth creation. Investment in pure scientific research is necessarily a charge on the nation, albeit an investment in its well being, but not in its wealth. More attention needs to be paid to redressing this imbalance by actively supporting the development of useable new technologies which will create the wealth for reinvestment, including investment in scientific research.

13 The often heard claim that science research expenditure necessarily underpins the prosperity of the nation is not true, as demonstrated by the disparities between the UK's excellent reputation in scientific research and poor industrial performance, compared with Japanese industrial strength despite their much weaker scientific base. This is a question of priorities and targeting. (It is significant that the Japanese are now funding a growing scientific base from successful industry in order to maintain their technological lead while the UK is finding it harder to maintain science funding from a faltering economy.)

14 Priorities should be:

- to develop the science base in areas where it is likely to contribute to improving the technological competitiveness and engineering excellence of UK industry, thereby improving the economy;
- to direct funding to the development of technologies applicable to engineering and to industry;
- to create, from current disparate activities, an effective range of government funded research organisations, complementary to academia and the private sector, to support the above priorities;
- to create a single mechanism to advise government on scientific and engineering priorities across departments;
- to decide what is to be undertaken collaboratively, particularly in Europe, and what nationally;
- to influence education and training in science and engineering and the public understanding of the importance of wealth creating industries.

15 Much more encouragement is required from Government:

- to maintain and enhance the flow of technically literate people into industry, and into all other walks of life—the banks, City, Civil Service, accounting—and to develop many more engineers and scientists as broadly based managers, in addition to the specialists. This should improve understanding of the need to invest in R&D.
- to encourage companies to invest in R&D by fiscal measures. For instance, full development of industrial processes and products is very expensive, often two orders of magnitude greater than the related programme. The Treasury should be pressed to give priority to such ways of encouraging industrial innovation and expansion to help and facilitate "pull-through" of new technologies.

16 Through clearly defined co-ordination, the links between academia and industry could be improved to encourage maximum exploitation of the science base.

17 The Government should also support demonstration plants (with industry and academia) in areas of potential strategic value but with technology which might not yet be profitable. Some environmental and alternative energy projects are good examples. The Japanese used this approach to develop clean coal technology which was required for the reintroduction of coal following the oil crisis. They are now world leaders in many aspects of this work.

Answers to the questions asked by the Sub-Committee.

1. *What is public expenditure on the Science Base for?*

1.1 Public expenditure on the Science Base is considered to be for the pursuit of knowledge to sustain and continue development. It has the twin objectives of developing cultural values and of assisting the UK economy. To achieve these objectives the following main aims have been identified for such funding:

(a) advancement of scientific knowledge and understanding through enabling basic and longer term research to be undertaken;

(b) encouragement of the exploitation of discoveries to the benefit of the nation;

(c) provision of a supply of trained engineers and scientists for UK industry;

(d) collaboration on international "big science" where the scale of financing is beyond the capability of the UK.

To sacrifice one of the objectives for the other would be detrimental to national life. Specifically, we cannot concentrate on cultural aspects but live in penury, nor do we want a society in which economic benefit is considered to be the only worthwhile objective.

1.2 The advancement of knowledge in key strategic technologies is necessary to improve industrial competitiveness and to underpin national economic development. The quality of researchers is set by the world-wide activity of curiosity driven research. Hence, participation in such leading-edge research provides a source of expertise, of international quality at the frontiers of knowledge. It also serves to encourage and inspire students to think imaginatively, creatively and constructively. By having such internationally recognised researchers we are able to participate in international exchanges to aid intellectual and cross-cultural stimulation whilst also remaining attractive for our own researchers to stay in, or return to, the UK. Such internationally able people, knowledgable of world-wide progress, are able to provide advice to UK policy makers in terms of identifying those technological advances important for development and with potential to contribute to the well being of the nation.

1.3 Seeking potential value in new scientific discoveries requires the continued input of the leading-edge researchers and the participation of those companies or institutions capable of exploiting any worthwhile resulting discoveries or inventions for profit. Whilst some financial contribution from potential exploiters is desirable, the chances of success are so slim for any company that continuing financial support is required from public money. It can well happen that any truly valuable discoveries are best exploited by new companies or institutions.

1.4 All these aims should be met by Universities working very closely with industry and against well defined technological strategies covering both emerging technologies and improvements to mature technologies. Initiatives taken by Government on the LINK and Teaching Company Schemes, aimed at encouraging close research collaboration between industry and Universities and the commercial exploitation of R&D products, are supported. However no real attempts are being made to prioritise research for the economic benefit of the nation.

2. *What are the objectives and priorities of the various funding agencies within Government?—Research Councils, HEFCs, other departments. Are they related? Is an overview required, and do the existing structures (ABRC, ACOST, OST) provide it?*

2.1 There is a strong opinion that this country does not have an adequate solution to the provision of an overview and the intelligent selection of priorities and strategies. The whole approach to the funding of science and technology has been described as amateurish in comparison with the systems in use in the USA and Japan. There is an urgent need to move away from the present regime where funding decisions are taken by part-time committees and to establish proper mechanisms for determining national priorities for economic improvement and to encourage scientific research and commercial involvement in achieving them. It is proposed that a professional, full-time, civil service type organisation with the responsibility for allocating the limited resources to best effect for the UK be established. The Select Committee should examine the way in which other countries, notably the USA and Japan, organise their priorities for the Science Base.

3. *What are the relationships connecting Government funding of the Science Base, funding by industry and charities, and overseas funding (particularly from the EC)? Various people are "paying the piper": are they calling different or incompatible tunes, and if so is this is a bad thing?*

3.1 In technological areas Government funded research programmes in universities can complement an industry's directly funded or co-funded projects. The distinction between industry and Government funded research is that the latter would be directed primarily at extending knowledge or exploring novel techniques whilst the former would be aimed at achieving defined objectives and specific applications, albeit in the longer term. Through close collaboration between a company, Research Council and University it can be ensured that research proposals meet the objectives of the participating bodies. This system is able to provide value for money and agreed deliverables to time and cost with the R&D products finding useful applications to meet the company's business objectives. With regard to EC funding of research it is felt that Government should provide advice and guidance to industry to ensure the UK receives a fair share of the available funds and exploits fully the EC programmes of research.

3.2 In an area as diverse as the Science Base it is inevitable and no bad thing that a number of different tunes are being played. Industry will identify and fund specific items of research which it believes will provide some financial return. Ideas and projects which are not supported by one body can find support elsewhere, as in the United States with its multiplicity of grant awarding bodies. Citizens will donate money to charities funding research into specific diseases and expect that money to be spent on finding a cure for those diseases. However, this does not change the need for more thinking and planning at a national level as to what is likely to serve the nation best. An adequate solution must be found for the provision of an overview and the intelligent selection of priorities and strategies. Many of the decisions taken may prove to be faulty but that is not an excuse for doing no planning whatsoever. The potential gain to the Government is that if priorities were determined in a professional manner, others with access to that information might decide to use their money to support those aims.

4. *What information and advice is needed by those who are setting priorities? How do they know what is going on in current low-priority fields? How do they track developments overseas?*

4.1 The information and advice needed by those who are setting priorities will be voluminous, coming from many sources and countries. A professional organisation is required to seek out the information and to prepare unbiased reports for consideration by the priority setting body.

4.2 In relation to University research, the following information is important to those setting priorities:

(a) Government and industry need to develop technology policies to provide the framework within which priority decisions can be made in major technological areas;

(b) At a more detailed level, it is important for industry to indicate potential benefits and wider markets or product applications in relation to new technologies;

(c) Academic institutions need to provide information on feasibility, likely timescales, risks and uncertainties, and costs of pursuing particular research in these areas;

(d) It is essential to review the international "state of the art" in particular of technology to avoid duplication;

(e) All these factors need to be thoroughly debated by representatives of Industry, Government and Universities before priorities are set for major Research Programmes.

With regard to low-priority areas, these must also be kept under review and upgraded in priority if the prospective benefits improve. For overseas developments, databases should be developed which track research results and publications, to avoid duplication, and to concentrate limited resources in the most useful areas.

5. *How do charities and companies which fund research set and implement priorities? How is it done overseas? Are there lessons here for the Government?*

5.1 A typical way in which a company would set its R&D programme priorities is:

(a) Ensure that all priorities meet defined Company business objectives and are supported and funded by in-house appropriate departments or the Company's Executive;

(b) Ensure that all short/medium term applied research and development projects can be justified on a cost/benefit basis, to enable a ranking of projects and the selection of the most profitable ones;

(c) Ensure that longer term research projects are considered against longer term technological trends in the high priority technology areas, and will meet the Company's strategic objectives.

This is implemented through an annual short/medium term R&D planning process which is overviewed by a Company R&D Review Panel, chaired by the Chief Executive. The outturn on all R&D projects is reviewed annually to ensure agreed objectives and targets are being met.

5.2 With regard to the implementation of priorities:

(a) The Government needs to examine the ways in which other countries, notably the USA and Japan, set their priorities for the Science Base.

(b) The Government needs to define its strategic and technological policy objectives in relation to the development of the Science Base. The forthcoming White Paper being prepared by the Office of Science and Technology will be an important element in this regard.

(c) The Government needs to drive its Science Base research programmes against these policy objectives and review progress and benefits derived from the programmes.

(d) The Government needs to keep under review priorities in the light of research done both at home and overseas.

(e) The Government needs to develop further the present arrangements which encourage collaboration between Universities and Industry (LINK and Teaching Company Scheme).

Industry, Charities and Government Departments. The Committee are particularly interested to know:

a. *What you are putting into the Science Base*

The Academy undertakes the pursuit, encouragement and maintenance of excellence in the whole field of engineering, in order to promote the advancement of the science, art and practice of engineering for the benefit of the public. The Academy is not bound by any specific limits to its areas of interest but targets its efforts on matters of primary importance where it can make a significant contribution, in concert with others if appropriate. The Academy fulfils its aims by developing collaborative projects, mounting public events and administering grants and awards. By promoting a multi-disciplinary approach, in order to bridge traditional divisions, it demonstrates the interdependence of different areas of expertise in the effective use of modern technology and engineering. Emphasis is placed on the importance of well-informed communication between engineers, research establishments, industry, public services and academia.

Much of the Academy's work involves engineering and educational studies, some of which are initiated by the Academy while others are carried out on a contract basis for outside bodies. In addition, the Academy

— co-sponsors with industry *Senior Research Fellowships* and *Personal Chairs* at universities;

— funds *Visiting Professors in the Principles of Engineering Design;*

— financially supports secondments of academic engineering staff to industry;

— provides funding for *Engineering Secondments Overseas* and *International Travel Grants* for British Engineers. It also administers the DTI *Engineers to Japan Scheme;*

— administers *The Royal Academy of Engineering MacRobert Award* for technical innovation (the premier national engineering prize);

— with funding from the Gatsby Charitable Foundation, government departments and industry, operates an extensive education programme called the *Engineering Education Continuum,* which supports activities for engineering students from sixth form through university to early professional level. Each phase of the Continuum has a number of grant schemes: the *Management Fellowship Scheme* enables young engineers to undertake international MBA courses; the *Sir Angus Paton Bursary* and the *Panasonic Trust* fund continuing professional development at Master's degree level; the *Esso Higher Education Award Scheme* and the *ICI Fellowship Scheme* aid the recruitment and retention of high calibre young chemical engineering lecturers at UK universities; and the *ICI Scholarship Scheme* for chemical engineering PhD students.

b. *What you are getting out of it, and whether this meets your expectations*

The absence of a clear statement of priorities for government funding in support of the science base has meant that the practical application of scientific knowledge to the wealth creating sector has not received the attention which we believe it deserves. Certain companies, however, because of their long involvement with technological development have probably obtained significant value from the existing arrangements, despite their evident limitations.

Those companies which presently make best use of links with the Science Base are invariably in the manufacturing sector. However, another important contributor to GDP, also within the sphere of engineering, is the construction industry which, it is generally acknowledged, underspends on research, claiming that its research is done on the job when addressing specific needs. There are indications that this attitude is changing but encouragement is needed to hasten the change.

Wih regard to the Science Base as a whole, changes are required to clarify priorities and to simplify and speed up decision-making concerning resource allocation to particular programmes and projects. On the first point a good start seems to have been made with the formation of OST. Its permanent role has not yet been defined, however, and it will need substantial reinforcement if it is to deal effectively with the question of priorities. The active participation of people with industrial experience will be vital to its success. Although there are varied views on the preferred structure of funding institutions, there is strong support for more emphasis on the engineering and industrial side, and a much greater use of co-funding arrangements with industry to provide continuing company commitment. The LINK Programme has been effective but is complicated by its administration procedure. It is perhaps linked too directly to the methods of solving problems rather than addressing specific needs, often defined by subject area. If productive relationships between industry and academia are to grow, flexibility coupled with quick decisions on funding are essential. The need for further schemes for liaison between academic institutions and industry is doubted.

Examination of witnesses

Dr Adam Neville MC, FEng, FRSE, Consultant and Arbitrator, A & M Neville Engineering, formerly Principal and Vice-Chancellor, University of Dundee, Dr Michael Edwards OBE FEng, Principal Engineer, Unilever Research, Visiting Professor, Chemical Engineering Departments, University of Bradford and UMIST, and Professor Daniel McCaughan OBE FEng, Director, University and Scientific Relations (Europe), BNR (Europe) Ltd, Professorial Fellow in Micro-Electronics, Queen's University of Belfast, were called in and examined.

Chairman

684. Dr Neville, you and your colleagues are very welcome here. Would you like to say anything, by way of an introduction?

(*Dr Neville*) I would like to make one comment and that is we very much welcome the White Paper. We welcome the fact that there is going to be some overview of where public money is to be spent, and that there is a concern about maintaining and developing the science base. More specifically, in a more partisan way, we welcome the establishment of the Engineering and Physical Sciences Research Council, not only because it will enable engineering to be funded in a more proper way, but we hope also because it maintains the unity of engineering and the physical sciences, the two having a very close inter-relationship.

685. That is very interesting because I had somewhat lamented the fact that biotechnology was being taken out of the Scientific and Engineering Research Council and was being put with others like biology and agriculture—whereas one of the major contributors in the biotechnology business is chemical engineering, and all the control engineering that goes with biotechnology plants—these things remaining the province of the new Engineering and Physical Sciences Research Council. I suspect that some damage has been done there. Do you disagree?

(*Dr Neville*) Yes, my Lord Chairman, I think—

686. Does "yes" mean you agree or you disagree?

(*Dr Neville*) What I mean is that one has to draw a line somewhere and even if we had a single Research Council there would have to be some sort of division. It is impossible to draw a line in this world where everything is so intertwined and inter-dependent without sharp edges. I do not mean we are going to go back to the situation of Dr Arnold, but we can no longer have these clear divisions. Yes, there is the disadvantage of having that division; but, first of all, if you look at the Medical Research Council it also involves biological aspects and it also involves control engineering and so on, and it is not possible to have it all together. Secondly, I think from the national point of view, putting biotechnology at the forefront of a Council concerned with everything bio is a good thing. I hope that there would be sufficient collaboration and that the arrangement between the Councils would be such that the boundaries would not be impenetrable.

687. Is it your impression that the White Paper intends that the new Director General of the Research Councils will have powers to make sure that these borderlines are not impermeable membranes, at any rate? What message would you have for the Director General in that respect?

(*Dr Neville*) His role, as I understand it, is to do with policy and not with details. He would not be concerned with the matter of detail of how one draws the line for applications, or whatever, between biotechnology aspects of chemical engineering and some other production aspects of chemical engineering. The advice, so to speak, would be to make sure that there is a provision for inter-boundary co-operation and for inter-boundary reviews.

(*Dr Edwards*) I am a chemical engineer by training, so I have a vested interest in your question.

688. I noticed you hopping up and down!

(*Dr Edwards*) We have to make the divisions between Research Councils somewhere. There will be interfaces to manage. The one that we have now created for biochemical engineering is one that, not we *should* address, but we *must* address, because in the United Kingdom we have few areas of outstanding excellence, groups of international standing. In biochemical engineering we have such university groups. It is absolutely essential that we manage that interface across the Engineering and Physical Science Research Council and the new Biotechnology and Bioscience Research Council. To transfer the engineering element across is absolutely critical for the wellbeing of the United Kingdom's economy, for example, the pharmaceutical industry, the chemical industry and the food industry.

(*Professor McCaughan*) The fundamental point is that we live in a matrixed world where things are not interacting in simple straight lines, and therefore everything we do has to work in a matrixed way. We are talking, at the moment, about biotechnology and bio-engineering, but since we are setting the framework in the way in which we are now going forward for what is likely to be the structure of the management and funding of science and engineering for a number of years, then it is very important that we set a flexible structure in such a way that it can respond to all the cross-boundary and cross-disciplinary things that will arise in the next 20 years.

689. One of the things that struck us about the written paper you have given to us, was your remark about the imbalance between investment in pure scientific research and useable new technologies which will create wealth. Are you saying that we are spending too much money on basic research?

(*Dr Neville*) No, we are not trying to jack ourselves up, so to speak, at the expense of pure research. Our submission starts by recognising the role of pure research, not only in long-term possible practical terms, but in what we would call cultural value, and it is probably not necessary to define that. Money is in limited supply, and if the choice is to support primarily pure research and leave engineering and technology as something which might pick up the crumbs, then I think we are going to beggar ourselves

[Chairman *contd.*]

further as a country, and that is going to stop us from having enough money for any research.

690. Your written statement and what you have just said now, if I may say so, is riddled with ambiguity which arises from the use of the words "applied" and "basic". Some years ago, at the time of the Rothschild debate, I tried to sharpen this up a bit by talking about "basic research" in the "pure and applied sciences" on the one hand (so you could have basic research in engineering) and "programmes of applied R&D", on the other hand, which is what industry does. What are you talking about here? Are you saying that industry is not spending enough on applied R&D, something with which I would agree, or are you saying within the basic science budget too much is being spent on subjects like biology and chemistry and not enough on subjects like material science and mechanical engineering?

(*Dr Neville*) No, we have tried to avoid saying too much money and not enough money. I did not use the word "applied"; I used the word "basic" science.

Lord Porter of Luddenham

691. You used the word "pure", which I think is different.

(*Dr Neville*) Yes.

692. You used the word "pure", not "basic".

(*Dr Neville*) I meant "pure" and "engineering".

Lord Porter of Luddenham] It is probably hard to have pure engineering. You can certainly have basic research in engineering.

Chairman

693. The distinction is whether it is something that industry is doing, or whether it is something that is going on in university and Research Council institutes—the latter being what we would define as the science base, in which basic research goes on.

(*Dr Neville*) Industry should spend its own money on development. I was trying to distinguish—and one can divide research and technology in a variety of ways—between that which has a clear-cut medium-term or long-term practical objective of creating wealth as the jargon has it, on the one hand, and research where we do not know what the answer is, we do not know what is happening and we do not know what can be found out. It was this distinction which I was trying to make. We have to have enough emphasis on that which will encourage industry to put money in and to end up in some sort of wealth-creating activity.

(*Professor McCaughan*) I think again there is a whole spectrum, all the way from pure research into things which by no means could be described as having any industrial relevance whatsoever, through to the partnership kind, where many companies (including the companies that both my colleague and myself belong to) actually support very often what is basic research in a university environment. My own personal view (and I would not think it was the total view of the Academy) is that you first of all have to look at the size of the pot, and not necessarily accept that the size of the pot is limited and fixed for all time. Again, taking the view that one is looking at the structuring of science and engineering research for a number of years, I think that it is very important that we continue to ask the basic question: is there enough money going into science and engineering in this country? My own submission would be that there probably is not. If we look back over the last few years, it is perfectly clear that when government has helped to fund joint programmes, the knock-on effect into industry and back into universities has been that the overall spend in universities has been increased, not just on relatively applied things and things of immediate relevance, but on more basic things as well. If you look back, for instance, at some of the solid state work that was sponsored by the ALVEY programme, industry actually did a lot more unfunded work than merely matching the 50 per cent that was put in by the Government.

694. A process which benefits both sides?

(*Professor McCaughan*) Absolutely. Taking the question about basic science, I would be surprised, if one has a limited pot, if one could not perhaps look to manage some of the money that is spent in some of the big science projects perhaps more efficiently, and free a little more money to do some other things with it. That is a question of putting efficient management into programmes because those are equivalent to big industrial programmes. I think one could perhaps manage them a little more.

Lord Porter of Luddenham

695. Let us just, if we may, talk about the Engineering and Physical Sciences Research Council. It is all very well to say we all agree it should have more money, of course, especially for our own things, but it will only be given so much. Do you think the present balance between spending on the physical sciences and engineering is about right or would you want to pinch something from the physical sciences?

(*Dr Neville*) You are pushing me very hard!

Chairman

696. That is what our enquiry is about!

(*Dr Neville*) I think in the last few years, with the establishment of the SERC Engineering Board, the balance shifted somewhat towards engineering, but I would like it to shift further.

Lord Porter of Luddenham

697. Well, of course, that is not a surprise. If you ask a chemist, he will give you the same answer about chemistry, and so on. It has shifted quite a way and you might have said that it was about right now.

(*Dr Edwards*) If you look at our science-base in the United Kingdom, it is unquestionably strong. Where the United Kingdom fails is in converting that supremacy in science into wealth creation and social benefit, so clearly I think there is a problem of the infrastructure which we build on top of the sciencebase.

698. If you talk about the total funding of engineering and even the basic sciences, Research Council money is only a very small proportion. Most of it is industrial already, and most of it is in

[Lord Porter of Luddenham *contd.*]

engineering. The only hope for the basic physical sciences' long-term funding is from this little pot with the Research Councils, whereas your engineering, and most of the applied sciences, are largely funded—and should be—by industry. Is that so?

(*Dr Edwards*) I think there is a weakness in the infrastructure that we have to build on the excellent science that we do. If it is a question of improving our extraction of wealth and social benefit from the science pool, then we have to strengthen that process. The science pool is there already, but there has to be the intention to do more. As an industrialist, I am a great supporter of having the strongest possible science base.

Chairman

699. Is it true that industry funds the novel kinds of engineering work that it needs for its own purposes later on, or does it require Research Councils to support the development of engineering subjects in much the same way as they support the development of chemistry or physics?

(*Dr Edwards*) If you look at the track record, the answer is that industry clearly does not do enough. As a general statement, I think there are some examples where industry does play its part and I think as Professor Horlock said earlier, we ought to pick up some of these examples and model our activity on those good things that we do.

(*Dr Neville*) We cannot use the word "industry" with a single meaning. There is industry which can do research, develop its products, and sell them and make money. But there are things and activities which do not belong to an identifiable industry, or do not yet so belong. Nuclear power was an example, but there are even more mundane things like ship building. We got into a situation where there was no ship-builder strong enough to be willing to put any money into anything other than this week's needs. If it is national policy that we have a shipbuilding industry, it has, for example, to develop something new which is precisely what is done by the Japanese. If we do not develop, so be it.

(*Professor McCaughan*) We are actually living not just in our own little country, but in the Global Environment, and the best companies tend to do two things. First they tend to put a fairly high proportion of their overall turnover into a combination of research and development, and second, they will spend some fraction of that on fundamental research. There are quite a few companies represented in this country, both British national companies and companies from abroad that have strong R and D facilities here; that do all they can to put sums into helping with the university environment and do put money into basic programmes. In doing basic research one very often has a choice between doing things which may possibly in the longterm—15 or 20 years possibly—have some relevance to industry, either in this country or elsewhere; or things which are not. For example, one can study pure materials science, or basic work in materials science, or do basic work in physics of materials and devices, which could have a slant towards possible industrial relevance in the longer term. My personal view would be that I would like to see something of a shift—not a total shift, obviously, but a bit of a shift—towards encouraging those kinds of programmes. I would anticipate that in the setting up of a national Foresight Programme, and the way in which the OST is going to work, I would hope and expect that they would do some kind of work in that area, helping to develop a national strategy in some of those kinds of areas.

Earl of Selborne

700. Leaving aside, for the moment, the structure of basic research which we recognise is a sort of strength to the country and leaving aside, also, the question of whether we are seeking to rob Peter to pay Paul, let us just concentrate on the infrastructure which Dr Edwards believes is lacking. I wonder if you could be more specific as to whether we are looking towards industry to provide at least part of this infrastructure, or are we still looking towards Government?

(*Dr Edwards*) I think it would be a combination of several things that is required. One, I think, is a more lively, vital role for the Engineering and Physical Science sResearch Council. There is certainly a much bigger role to be played by industry in engineering research. This is absolutely vital, if our major companies are to succeed in the future on an international scale. Then I think there is a problem of having the financial institutions really geared-up to promote United Kingdom Limited and as we have heard earlier, this does not happen properly in this country. So I think the role the Research Councils have to play in this is rather a small one in developing a whole infrastructure that is required to go from scientific advance to commercial success. As we all know, it is not a linear process anyway. It is a very complex process. I think companies in the past have not helped particularly.

Chairman

701. That is why I wondered whether your phrase "building something on the science base" was quite right because that is a linear statement, if I may say so.

(*Dr Edwards*) Indeed, yes, but I think there has to be something. Some commercial opportunities do occur that way and others occur with us having a very incomplete knowledge of the science base, but then there is a role for scientists to fill in all the knowledge gaps and build and implement improvements and gradual developments. The big changes often come without the science being fully understood and I think we have to take into account this non-linear aspect of wealth creation.

Earl of Selborne

702. If I could pursue this further, you refer to the example of Japan in paragraph 13 of your paper. What lessons would you suggest that we should draw from the Japanese experience of technology, from what you describe as our "relatively weak science base"?

(*Dr Neville*) By that I mean it is something worth looking at and not necessarily emulating directly. There was one point which was made i.e. that Japan

[Earl of Selborne *contd.*]

put much more money into engineering, wealth creation and then used that money so created to direct herself towards basic science and pure science relatively late. The second point is that I think they have much more government planning—I would imagine too much—but they have established their priorities very quickly and very clearly, and there is a strong central influence on what is to be developed. The third point is that the ratio of scientists to engineers in Japan is the inverse of the ratio here. I have heard various figures of 1:4 or 1:6 and here 4:1, or something of that sort. I know the definition of what is a science graduate and what is an engineering graduate in different countries may not be the same, but these are things that we should look at.

703. Have you a thought as to what the ratio might be in this country?

(*Dr Neville*) No. I would not presume to give an answer like that. In this country I think there is a great confusion about who is an engineer, or what sort of a person is an engineer.

Lord Porter of Luddenham

704. It is purely a matter of words. For example, there are no chemists in Switzerland at all, they are all chemical engineers.

(*Dr Neville*) It depends upon the definition. We should look at these things and see what effect they have on performance in the country.

Chairman

705. I wonder whether we could come to the Technology Foresight and partnership with industry, and that part of the White Paper. Can I ask what role the Royal Academy of Engineering imagines it might be able to play in bringing these things about, perhaps in the development of the Technology Foresight programme itself?

(*Dr Edwards*) It is a very important area and the Royal Academy of Engineering has already established a group of people looking at technology forecasting for the engineering/manufacturing industries to see what is on the horizon; what will the world look like in 30 years' time; what will consumers demand; what will the demographic trends be; what sciences and technologies are currently emerging; and how these match together. We are embarking on that exercise. It is a very imprecise art, but I think it is at least a start. Within particular companies like my own we can look to the future and say: how would we wash clothes without water? You can start to do technology forecasting quite well with a specific objective like that in mind. In terms of "what is good for the wealth of the nation", it is a very difficult task, but I think it is an exercise which we should undertake very seriously, realising that it will not give complete answers.

706. Professor Horlock, in answer to a similar question, seemed to be very much more negative, if I may say so, than you have just been. Do you really disagree with him?

(*Dr Edwards*) I think it has to be treated with great caution. I think it is an exercise that the nation should try, and try very seriously.

Lord Porter of Luddenham

707. Would you agree that it is rather like predicting the weather, in the sense that one can make some useful predictions for a few days ahead but absolutely nothing for the long term?

(*Dr Edwards*) I think it is. It is impossible, as Professor Horlock said, to handle the major discontinuities. That is the problem. Still I think there is an importance to us saying, "Generally, we think this is the way we should be going", and we have to be sufficiently flexible to handle the discontinuities. I really think it is better to have some idea where science, technology and engineering will lead us, than leave it to its own devices.

Chairman

708. Do you think industrialists are better in that than other people?

(*Dr Edwards*) We have limited objectives, that we see what our consumers will need, and we see a particular product or process that we might develop, and so I think it is naturally easier to do in that context.

709. Do you therefore think it right that the chairmen of the new Research Councils should be industrialists?

(*Dr Edwards*) Might I be provocative? I think there has not been a lot of evidence over the years that our industrialists have spread light wherever they go over our science base.

(*Professor McCaughan*) May I contradict my friend and say that there are a significant number of industrialists who have been very supportive of the basic science research base in this country, and have contributed by their own efforts very considerably to that through the Royal Society, the Royal Academy and through a very considerable amount of industrial participation in SERC and other Research Council bodies. I think nobody should underestimate the level of effort required to get even a small fraction right in Technology Foresight. I would not agree that it is quite like weather forecasting, in that if you look back 20 years ago at what was being done in research and look at how many of those things are being applied now, you will find that there are very many areas in which basic research was being done 20 years ago, and which certain people at the time were saying would be important. I am thinking, for example, of the area of integrated circuits, and the use of certain materials, and what would be the advantages of those materials, e.g. optical fibres, and also of the relationships between industrial and government laboratories and academic laboratories in those areas. It is also true to say that an awful lot of things do not come off. I was very struck by the research that was mentioned in one of the recent papers from the Office of Science and Technology, that in a study recently in GE of 190 different technological areas, showing the percentage of R&D return from these, 50 per cent of the return came from five of the 190 different topics that had been researched. Picking winners is very difficult. What government can do, I believe, is help with infrastructure, and help put the generic things in place, support generic areas rather than very specific

[Chairman *contd.*]

areas, and within those areas look for the highest quality projects to be supported. The science and engineering people, and the people who are choosing budgets, should support projects of very high quality. I think there is an element of support of high quality that one must not lose sight of.

Lord Porter of Luddenham

710. You are not afraid that we might then miss the five?

(*Professor McCaughan*) I think that is always a risk. You cannot guarantee you are not going to miss the five by any process I know of, otherwise every company would be extremely rich!

Lord Dean of Beswick

711. I was interested to hear somebody mention the question of how the Japanese have progressed, having been there. There is no doubt about it, if you start to question the Japanese on how they approach some of these subjects, they are not the free for all capitalist society that some people project them as. There is massive investment in Japan in research on any scale and there is a massive financial investment to make sure that they get some of the basics right before they go into the development of what you would call their sunrise industries. I heard Dr Neville recite the question of the shipbuilding industry over here. Without being political, the shipbuilding industry over here really no longer exists, because the government did not decide that we had to have a shipbuilding industry. If we wanted one it had to be paid for in a market sense. That is why I do not think we are dealing on a level playing field. I would like to ask Dr Edwards, who has some sort of connection with the University of Bradford and UMIST: bearing in mind that UMIST is almost totally slanted towards industry—the various facets of it—do you see any evidence that the projects they do in conjunction with industry are rather higher than some of the other centres of learning in the country?

(*Dr Edwards*) I am the visiting professor at two universities.

712. Yes.

(*Dr Edwards*) May I answer the question indirectly? When I go to universities—in my own company we spend £400 million a year on research—my aim is to see something different in the universities. Particularly, in the work the Research Councils sponsor, I would like to think this is not a pale imitation of what we in industry do, but is something different and novel. The technological universities, Bradford and UMIST should still be doing background, pure basic science and engineering research that will give me new insight, new opportunities that I would not think of, and that is the sort of research that I think the Research Councils should pay for. On the other hand, you do expect some of the technological universities to have strong partnerships with industry where the work becomes much more applied, and we will start to pay for that. So I think there is a whole spectrum of activity that is required, but I certainly do need to see novel things in universities that my own company has not thought of, and that give us new opportunities for the future. So I certainly would not like UMIST, or Bradford, or any university, just to be doing contract short-term research.

713. Running in tandem with that, surely for the private sector, they would not become involved in an increasing investment, without having some idea that what they were doing was marketable at the end of the venture?

(*Dr Edwards*) For some of it yes, but who knows what is going to be needed in ten years' time? I think, again, you have to do part of the work, which should be focused, and you should have a fairly clear idea that it can be turned to success, but some, you have to fund and say, "Let's wait and see."

Chairman

714. Do I understand you to be saying that if novel ideas are produced and funded by Research Councils, which do attract you and your firms, then you might well be prepared to spend quite heavily on a continuation of that level, once you have recognised that it is in your book?

(*Professor McCaughan*) In my own company, there is another example. In the telecommunications industry we spend—it is in dollars because we are multi-national—$10 million per year directly in universities with no strings attached whatsoever. In universities across the world we support chairs, and support projects and programmes where we do not put deadlines, or dates, or time-scales, or anything else on them. We actually do it because we believe that it is in our long-term benefit to develop relationships with the universities. Clearly we do expect to get something out of it. We get the relationship with the universities and the relationship with the university environment. I think a lot of good companies do that. I think the Academy very much encourages these kinds of relationships through all of the expenditure the Academy puts into joint chairs, fellowships, sending engineers to Japan, and a whole range of things, which encourages the support jointly with industry and academia. We are looking, in fact, to help build up the university infrastructure in a way that makes them more aware of what industry is doing, so that if good things do come out of research then the universities, themselves, can be alert to the things that are being done and, of course, that means that the base behind that, which is funded by the Research Councils, must be strong. We are very, very keen that that base should be kept strong.

Lord Porter of Luddenham

715. The figure that Dr Edwards gave us, my Lord Chairman, was quite impressive. As I see it, it means that one company spends as much on research as all the Science Research Council do. I think that is so—you said £400 million?

(*Dr Edwards*) It is actually £450 million.

716. You think those figures are comparable? Are they? That is about the figure, I think that the Research Council spends.

(*Dr Edwards*) Yes, but let me just expand a little on that, because it brings in an aspect that we have not covered and that is the international dimension. Unilever spends its money anywhere in the world

[Lord Porter of Luddenham *contd.*]

where good research is done. So if it is in MIT in the States, or Tokyo in Japan, we will invest in the research there. We may well exploit this research in the United Kingdom, if we have a manufacturing process, or new products in the United Kingdom. Similarly, we may exploit technology from the United Kingdom and use it in Australia or Brazil, so this whole focus on United Kingdom Limited is quite a difficult one for a multinational company to handle and I think it means that the Research Council Chairman, or the Director-General, have to see the very international framework in which we operate.

717. I just wanted to be sure that those figures were comparable there. Is that £450 million research and development and if so, is a lot of it development? In which case they are not comparable because Research Councils do not really spend money on development.

(*Dr Edwards*) I have given you the budget of our Research and Engineering Division. I would imagine that 80 per cent of that is research and development activity and 20 per cent would be more routine engineering work which does not have a research element.

Chairman

718. Is it research work that you could find in university departments but it happens to be in your own department?

(*Dr Edwards*) Quite a lot of it, yes.

719. Is it the kind that you could find in a university department?

(*Dr Edwards*) Yes, currently, about 5 per cent of our budget goes outside to universities—and we are trying to build that towards 10 per cent. Then, of course, when we start to think there is something of commercial advantage we take it into the company,and use our own very significant resources for it to grow.

Chairman] But the £450 million does not include work undertaken in direct connection with projects which you have already decided to go ahead with?

Lord Porter of Luddenham

720. Development, in fact?

(*Dr Edwards*) There will be some development in that, yes. We class about a third of our research as "exploratory research" which is about developing understanding, (like research in universities). So about a third of that is what you would call "basic research" before we have a clear applied target in mind.

Chairman

721. So you would be thinking of about £150 million?

(*Dr Edwards*) Something like that, yes.

Baroness Perry of Southwark

722. It would be quite helpful to know from Dr Edwards what is the criterion on which you decide to put your £20 million currently, or £40 million in the future, into universities? Is this because you do not have the confidence yourselves, or is it because it is specifically not your kind of research?

(*Dr Edwards*) No, there is much more knowledge outside Unilever than inside, and we will tap that outside pool. We feel that we have to have strong outside contacts in three particular areas—biosciences, physical chemical sciences and manufacturing sciences—and we promote the best university links we can have in those areas, because we feel it will ultimately give us an advantage we can exploit in the market place.

Chairman

723. I asked the Royal Society what they considered to be the strong points of the White Paper and what they considered to be the weak points, and I think I should ask the same of you, if I may.

(*Dr Neville*) I think the strong point is that we might have a Government policy that is more coherent than in the past. I mentioned, at the outset, that there will be a new Research Council which will combine engineering and physical sciences. There will be a new body for the division of money, not consisting of people who are the recipients, and there will be somebody overseeing, that is the Director-General and the people advising him, who will be from different walks of life. In other words, there will be both the users, industrialists, academics and people from the Government. If I could add a point to something that arose earlier in discussion—should the Chairman of the EPSRC be an industrialist or should it be an academic?—I hope we do not always have to pigeon-hole people like that and give them a single label. I am not making a recommendation on who should be appointed, but my colleague here was an academic for 20 years and is in industrial research now. There must be people like that who understand both sides.

Lord Porter of Luddenham

724. Is it not unfortunate, therefore, that the White Paper does pitch it so that we are going to have an industrialist in the chair?

(*Dr Neville*) It is unfortunate if it is meant to be like that. Perhaps it can be interpreted as somebody who has an industrial background.

Chairman

725. What points about the White Paper are you least satisfied with? Or where do you think a lot of attention will have to be devoted?

(*Dr Neville*) I think the defence situation is not resolved. Maybe it was not practicable to be too outspoken about this. I think that is one area. Another one is the question of money, but it was not for the White Paper to print more money.

(*Professor McCaughan*) I thought that the defence section of the Paper was actually very weak. It was weak from several points of view. The first point of view is that it is clear that the Ministry of Defence is decreasing its spend. It is also clear that over the years laboratories, such as the laboratory at Malvern in which I worked for seven years, have been repositories for a tremendous amount of extremely good work, some of which has been exploited within

[Chairman *contd.*]

the United Kingdom and other of which has been exploited elsewhere. There really was no strong message in the White Paper about national policy for the continuing exploitation of this work in any way other than by the new Defence Research Agency effectively turning it into what amounts to a "company laboratory" for itself. There is no real discussion of the national good at all, and also no discussion of how, effectively, the money gained by the running down of that activity (as it clearly states it has done and will be doing) will be turned over directly pound for pound into the civil sector as, if you like, a genuine peace dividend for the improvement and increase of research and development for the United Kingdom. I was extremely disappointed about that. I also felt the White Paper was very weak in its lack of any real discussion about a way of increasing the national cake and the national spend on R&D. It did not explore, for instance, novel ways in which we can actually get greater benefit and persuade companies to put more money into R&D. I would just cite you two simple examples from other countries, because the case of other countries has been raised already. In Canada, for example, you do not just get 100 per cent tax credit for your R&D, you get 125 per cent tax credit for your R&D dollar. That means that companies, in effect, have more money to put into R&D, and they spend more money in universities and outside, and help build the science base as a result. Are you aware, for example, if companies give equipment, or give things to universities, that universities have to pay VAT? There is a whole range of silly things like that which could be considerably improved in the financial infrastructure, which would improve the funding within the university infrastructure, and the academic infrastructure and the science base which the Paper did not actually address. Relying mainly on the "LINK" programme is fairly weak, as it does not allow for large academic teams working with small industry teams, which are almost impossible under a "LINK" programme because of the way the funding is structured. It does seem to me it is a great pity that those issues were not addressed. I would hope those issues could be addressed following your own enquiries and your own discussions, and bearing in mind that there is going to be a new financial structure and new infrastructure. I hope these will be some of the things tackled by the Office of Science and Technology and by the new Director General.

726. We have an adopted Scot and a Northern Irishman here. You heard us discuss briefly with the Royal Society the regionalisation that seems to be going on in some aspects of the United Kingdom, certainly affecting the funding of higher education and the organisation to some extent, but not yet affecting research. There is always a question mark in my mind about whether eventually it is bound to affect the support of research too. I just wondered from your perspectives back home whether you have anything to tell us about those?

(*Dr Neville*) From my experience of Scotland I would say there is a very strong view in the academic community that research funding should be United Kingdom-wide based, for a variety of reasons ranging from direct recognition of quality in the large enough pool where one competes, to mobility of people, because academics by and large do not see themselves as being only Scottish academics who are not interested in, and not likely to move, elsewhere. I think that that should be preserved. I would imagine with the Welsh scene being even smaller, it would be even worse if the research money were allotted separately to Wales for competition there. As far as the university funding is concerned, I think it has happened. It is not likely to be undone. There is no great harm (there is some harm) if the teaching element is funded separately by region or country. The real difficulty comes with the research element of the Department for Education notional allocation which goes to the Scottish Office and so on. I envisage some difficulties there. There is a disproportionate number of universities in Scotland and, therefore, it is possible that the funds are not going to be satisfactory either looked at from one side of the border or the other. It all depends on whether that funding is going to continue in that form.

(*Professor McCaughan*) May I comment as, until a few weeks ago, I was Chairman of the Board of the Industrial Research and Technology Unit, which is the Northern Ireland body responsible for funding from both the former Technology Board (of which I was also Chairman for six years), and the extra funding in Northern Ireland for research associated with industry. I do not think anyone really would argue that you have to have a very strong, centrally driven, centrally funded programme of support for basic research. I do not think regional programmes would substitute for those. However, when you start to look at the links between industry and academia, I think there is an awful lot that can be done on a regional basis as well as on a central basis. Again, I personally would not say that it should be, in any way, a complete substitute for a good strong relationship between the Department of Trade and Industry, all of the Research Councils and all of the central funding agencies. I do not think these should be substituted purely by regional activities. On the other hand, the people who really care about, say, Newcastle upon Tyne tend to be the people who come from Newcastle upon Tyne, and similarly with Scotland, Northern Ireland or central London. There is room for a very strong element of local funding. In the case of Northern Ireland when the Technology Board for Northern Ireland was started, there was no particular pot of money allocated to funding; but we developed, in fact, a strategy for Northern Ireland where we identified key areas for Northern Ireland, including software and food technology, in other words several areas which were important for the local Northern Ireland economy, and we then got a budget from the Northern Ireland Office over and above the Science and Engineering Research Council budgets, and we funded basic research and basic programmes. We asked for calls for proposals from universities; we then funded programmes jointly with industry in Northern Ireland. The latest round of things which have been done in Northern Ireland, again over and above anything done by the SERC, is joint programmes between companies in Northern Ireland, companies on the mainland here in England, universities on the

[Chairman *contd.*]

mainland and universities in Northern Ireland. I would cite one example of a programme on composites by Shorts, where there is a programme of basic technology going on, and basic research being done in the Northern Ireland universities, with the very basic programme there looking at the long-term properties of materials, and the long-term material issues, but it is combined within the company with a programme for looking at aircraft structures, combined with the basic research into structural materials and structural science. It seems to me that there is a very, very good example to be followed in what has been done in Northern Ireland. There have been similar things, although perhaps not quite so intense, in Scotland and Wales. It does seem to me that those are very, very good examples which should be looked at very strongly by the new bodies.

727. Would an Englishman like to join in with that?

(*Dr Edwards*) No, I think I have nothing to add.

Lord Dean of Beswick] The reason that happens in Northern Ireland is because they get quite a considerable multiplier as to the rest of the United Kingdom because of the problems of Northern Ireland.

728. Thank you very much for coming along and assisting us. It has been a very enjoyable afternoon altogether.

(*Professor McCaughan*) Thank you for the opportunity for coming along.

(*Dr Neville*) Thank you very much.

WEDNESDAY 7 JULY 1993

Present:

Butterworth, L.	Flowers, L. (Chairman)
Dainton, L.	Selborne, E.
Dean of Beswick, L.	

Memorandum by the Chemical Industries Association

The Chemical Industries Association is the major body representing the UK chemical industry, with a membership which is drawn from all sectors of the industry including some of the UK's most successful and innovative companies.

The chemical industry is the UK manufacturing sector's number one export earner with a net export surplus of over £3 billion in 1992. However, of greatest significance in the context of this enquiry is the industry's strong dependence on scientific and technological innovation through effective research and development, to remain competitive and satisfy the needs of its customers. Because of this the chemical industry invests more of its own money in research and development than any other manufacturing sector, approximately £2 billion, over six per cent of total sales revenue in 1992.

Apart from its own industrial activities, the chemical industry is heavily involved in a wide range of collaborative projects with public sector research institutions, successfully translating academic research into commercial products and processes.

From this background it is clear that government policy in science and technology, laid out in the recent White Paper, is of intense interest and significance to the chemical sector.

We are therefore grateful for the opportunity of submitting evidence to this enquiry, "Priorities for the Science Base", on behalf of our member companies. We hope that the demonstrable success of the chemical industry will lend weight to the comments we make here.

We have confined our comments to those areas of the Sub-Committee's enquiry which we believe are of particular significance, especially in light of the White Paper. For convenience we have numbered these comments in accordance with the questions listed in the Sub-Committee's call for evidence.

1. *What is public expenditure on the science base for?*

Although science and technology have an intrinsic cultural value, they are the driving forces for innovation and wealth creation. As the economies of developed countries become more dependent upon technology-based industry, the UK must regard its traditional strength in research as a source of competitive advantage for its manufacturing sector. A strong science base will become an increasingly important factor in attracting inward investment by international companies operating in a wide range of manufacturing activities.

This has always been the case for the chemical industry, which has thrived through a strong commitment to, and the successful exploitation of, industrial and public sector research and technological development.

Public expenditure on the science base is vital in providing a source of leading edge research expertise, particularly in areas of science and technology which underpin industrial activity; it is essential for the provision of well trained graduates and postgraduates for industry and the academic sector; and, through programmes designed to promote collaborative research and technology transfer, it provides a basis to facilitate productive interaction between industrial and academic research activity.

2. *What are the objectives and priorities of the various funding agencies within government?—Research Councils, HEFCs, other departments. Are they related? Is an overview required, and do the existing structures (ABRC, ACOST, OST) provide it?*

The objectives and priorities of the various funding agencies within government should be to support the science base and achieve the goals summarised in our answer to question one.

In its submission to the OST as part of the consultation process for the White Paper on Science and Technology, this Association stressed the need for greater cohesion between the various funding agencies and government departments, under a clear and co-ordinated strategy. We have therefore welcomed the establishment of the OST as a central body directing overall policy, and we are encouraged that the White Paper contains a strong emphasis on the importance of wealth creation and partnership between government, industry and academia.

The proposal to replace the existing advisory structures of ACOST and ABRC (with the Council for Science and Technology and the Expert Group advising the Director General of the Research Councils, respectively), is also welcome but we hope that the advice from these new bodies will be delivered openly, and acted upon. The formulation and implementation of government policy will depend upon the success of the "Technology Foresight" and "Forward Look" initiatives, which will in turn depend upon close liaison between, and within, government, industry and the academic sector, *ie* partnership, as mentioned above.

We stress that whereas we welcome the move to focus government support, through the Technology Foresight programme, on science and technology which underpins the creation of wealth, care must be taken to ensure that this support is directed towards wide, generic areas which are relevant to large sectors of industrial activity. Allowance needs to be made for a degree of diversity to ensure that "curiosity" research is not stifled and cross-disciplinary research is not discouraged.

4. *What information and advice is needed by those who are setting priorities? How do they know what is going on in current low-priority fields? How do they track developments overseas?*

We regard these considerations as central to the objectives of the Technology Foresight and Forward Look programmes referred to above. There must be strong representation from industry on all the relevant advisory bodies to ensure that these programmes are effective in their pursuit of wealth creation through innovation, taking account of the needs of industry in the same way that industry must take account of the needs of its customers. This will also be necessary to track developments in low priority fields and in overseas technology; in the latter respects, the feedback from large, multinational companies which operate abroad will be of the utmost importance.

The role of the DTI will be critical especially through the work of the sector divisions. Again we stress the importance of the concept of partnership, and the need for co-ordinated action under a central strategy which will enable UK companies to take full advantage of national schemes promoting collaborative research and technology transfer, and allow the UK as a whole to derive the maximum benefit from European initiatives, particularly those under the Fourth Framework Programme.

8(d) *What are the impacts on priority-setting of formula-funding, research rating and moves towards an R-T-X model?*

Government has not yet made it clear what will be the impact of research rating exercises on the development of the so called RTX system, although it is difficult to see how they would not be directly linked. When the idea of creating teaching-only institutions was first mooted, this Association stressed two major points which we believed, and still believe, should be taken into account.

Firstly, teaching and research, in practically-based subjects such as physical and biological sciences and engineering, are mutually dependent activities. High quality graduates in these disciplines must be familiar with modern research equipment and techniques which will only be available within active research departments.

Secondly, we would make the general point that much of the research conducted within the higher education sector, which is valuable to the chemical industry, is small scale research, performed by individuals or groups in large and small institutions, which may or may not be "highly rated". Recognition of this fact is reflected by chemical industry support which is often at the level of the individual, rather than the department or the institution as a whole. In other words, high quality research should be supported wherever high quality researchers are performing it.

9. *The Research Councils have explicit missions. How are these translated into priorities, by whom and on what basis?*

and

11. *Are the priorities of the Research Councils skewed by the boundaries between the Councils' remits, by the existence of Research Council institutes, by international obligations to support "big science", or by anything else?*

In the CIA paper "Chemical Research Priorities in Industry and the Public Sector" which was published in 1992, we voiced the concern expressed by our member companies that there was growing mis-match between industrial and public sector research priorities, and inadequate support, through bodies such as the SERC, for disciplines which underpinned large sections of industrial (and hence economic) significance. We also regretted that, under the old SERC regime, small scale research had to compete directly for funds with large scale research and international collaborative initiatives such as CERN. This had led to a decline in small scale research, much of which was crucial to the support of the science base.

We therefore welcome the proposed separation of the SERC's dual roles of supporting "science for culture" and "science for wealth creation", with the establishment of the Particle Physics and Astronomy Research Council (PPARC) and the Engineering and Physical Sciences Research Council (EPSRC). We are very concerned, however, that the Biotechnology Directorate and biological sciences are to be transferred to a separate Biotechnology and Biological Sciences Research Council (BBSRC). We regard this as an artificial split which does not take account of the interdependence between biology, chemistry, biotechnology and engineering. There are many areas of science and technology of great industrial significance which rely on expertise in all of these disciplines simultaneously: biotransformations and new, clean technologies for example; indeed, the whole process of developing and manufacturing a pharmaceutical product.

To make the proposed new structure operate effectively to meet the needs of the chemical industry would require very close co-ordination between the EPSRC and BBSRC and adequate cross-representation on the two bodies. Given the separation of big and small science, we would have expected biotechnology and biological sciences to be retained, with engineering and the physical sciences, within a "small science" research council. We have urged the OST to think again about this proposal.

To answer the final questions posed by the Sub-Committee, we would like to make some comments on how the chemical industry contributes to the science base, and how it benefits from it.

The chemical industry has always relied on the wealth of knowledge and expertise available to it from the academic sector, recognising the industry's economic dependence on research and technological development. A significant proportion of its R&D expenditure is devoted to maintaining an extensive network of links with the academic community through direct support or various kinds of collaborative research activities, all of which have helped the industry to prosper. It is worth noting here that member companies of this Association account for six of the top eight companies participating in the CASE scheme, for example (Co-operative Awards for Science and Engineering) and the chemical sector is a prime contributor to initiatives such as LINK and the Interdisciplinary Research Centres. Chemical industry funding for higher education institutions totals approximately £50 million per annum in direct support: this is roughly equal to the amount spent on support for core chemistry through the SERC. This support takes many forms apart from contract and collaborative research; direct support for Chairs in science and engineering, funding graduate and postgraduate prizes and employing academic consultants, for example.

As we have stated in our answer to questions 9 and 11, we have identified a lack of strategic support for public sector science which underpins the research activities of the chemical sector. This has meant that support for the industry's core interests in research has not reflected the sector's strong record of successful collaboration with academia, or its proven ability to create wealth through scientific and technological innovation. We believe that the White Paper on Science and Technology has provided a general framework which will allow our concerns in this area to be addressed.

Finally, we would wish to re-state the chemical industry view that the primary role of the science base is to provide a supply of well trained graduates and postgraduates for industry and the academic sector. We therefore regard teachers, and the role of teaching, within the science base to be of paramount importance.

Letter and memorandum from the Association of the British Pharmaceutical Industry

The Association of the British Pharmaceutical Industry (ABPI) thanks the Select Committee on Science and Technology for the opportunity to put forward the views of the pharmaceutical industry to the inquiry into how priorities are set, and implemented for the UK Science Base.

The Association has already provided the Committee with our submission to the Office of Science and Technology's consultation exercise on the White Paper, together with a copy of our oral evidence to the House of Commons Select Committee inquiry in the organisation of the Office of Science and Technology. Attached for the attention of the members of Sub-Committee 1 are some additional views of the Association on the specific questions raised in the call for evidence. Two appendices are included:

- The initial views of the Association on the proposed establishment of a Biotechnology and Biological Sciences Research Council.
- Correspondence from the Association to the Office of Science and Technology expressing concern to the Chief Scientific Adviser on the implications for R&D in the UK in respect of the Department of Health's proposal to extend the Limited List of medicines.

Dr Jeff Kipling
Associate Director
1 July 1993

INTRODUCTION

The Association of the British Pharmaceutical Industry (ABPI) is the trade association representing the great majority of pharmaceutical companies in the United Kingdom which are engaged in discovering, developing and manufacturing prescription medicines. ABPI member companies supply more than 95 per cent of the medicines used in the NHS annually.

The British pharmaceutical industry has consistently been one of the most successful sectors of industry in the UK over the last 40 years and is one of the most innovative industries in the UK. Five of the 10 top-selling medicines in the world are the discoveries of UK-based companies. In 1992 it contributed £1.3 billion to the

UK's balance of trade, and its combined exports exceeded £3 billion. The pharmaceutical industry spends a considerable amount on R&D in-house. In 1992 this was over £1.3 billion.

The Association welcomes the opportunity to provide evidence to this important inquiry coming as it does after the recent publication of "Realising our Potential", the White Paper on Science, Technology and Engineering.

The Sub-Committee defines the science base as "all scientific, technological and engineering research and post-graduate training, however funded, conducted at, or in close conjunction with, universities and Research Council institutes". We suggest that it should in reality be seen as covering also science and technology within the industrial and government science sectors. All of these sectors should see themselves as components of the UK science base.

The research objectives within the pharmaceutical industry are aimed at the discovery and development of new medicines. This means the industry is dependent upon innovative science in order to understand human diseases and to design new drugs to treat them. The industry is also dependent upon a range of scientific and technological activities during the phase of formulation, safety, and efficacy testing during the development of a new medicine. This is to provide improved chemical processes for manufacture, for finding better ways of formulating medicines for effective delivery in the body, and for optimising the safety, quality and efficacy testing of new medicines.

Like most other industries the pharmaceutical industry is critically dependent upon the public sector science base for the provision of well trained scientific and technical staff for its R&D activities.

In its call for evidence, the Sub-Committee invited comments on a number of questions. We have attempted to answer these below although it will be appreciated that some of them may be better answered by the Chairmen of the Research Councils, and representatives from appropriate Government departments (eg, DTI, DoH, DFE etc) and the Medical Charities.

1. *What is public expenditure on the Science Base for?*

We suggest the following are all relevant:

- To maintain and strengthen the excellent contribution of UK scientists and engineers to the overall knowledge and cultural base of the world community by discoveries in both fundamental and applied science and technology. It is important that the UK retains its position as a major net contributor to the totality of scientific and technical knowledge, since this not only provides a basis for the UK to have a major influence on scientific policy within the international community, but also to retain (and attract) the best scientists and technologists on which the future success of Britain as an industrial nation depends.
- To provide the essential knowledge base and intellectual underpinning for the country to maintain its place as a premier industrial nation in the increasingly scientific and technologically driven industries which will dominate the world economies in the next century.
- To support the infrastructure of the science, technology and engineering departments of the academic institutions to allow them to carry out their work to the highest possible international standards. We do not see it as the responsibility of industry or the charities to fill the void created by inadequate Government support. A decline in the standard of the science that can be practised is the inevitable consequence of a weak infrastructure.
- To reflect national priorities in specific areas and disciplines, and to serve as the foundation on which to build national interests including competitiveness and wealth creation. However, it is not the function of Universities and Research Council Institutes to undertake research which has as its sole aim the production of marketable products and commercial inventions, but rather to provide the intellectual and knowledge infrastructure on which UK industries can build. Nor is the Science Base there to serve merely as a contract house for UK industry, and should not be carrying out routine screening or providing services which are most appropriate for industry itself. The main function of the academic Science Base is to engage in *fundamental* research within defined national priorities.
- To provide the funds required to support this fundamental or "curiosity-driven" research which is essential for the development of the inquiring mind and for creative science. Academic science and technology departments require some uncommitted funds to assist young scientists to carry out studies that have no immediate project-related justification. The decline in availability of seed-corn funds for academic departments is made worse by the pitifully low level of financial support provided for the laboratory work of PhD students.
- To provide a strong output of good quality, highly-trained scientists, engineers and technologists for industry, commerce and academia. Young scientists must be given the education and training in science and technology which is required in the last decade of the twentieth century and beyond. The provision of people with competence and skills in science and technology is of vital importance for all sectors of UK science. Furthermore a failure of standards of education and training will result in a drain of our best young scientists towards competitor nations. The recent trend towards reducing

the amount of practical experience in undergraduate science courses (because of financial constraints) is to be deplored, and although industry can provide a large number of "sandwich" places which have a very high practical content, the total number of such places is very limited compared with the number of undergraduates taking science courses. In addition there is a strong requirement for continuing training at all levels, and only in the last few years has the higher education sector started to address this issue.

2. *What are the objectives and priorities of the various agencies within Government?—Research Councils, HEFCS, other departments. Are they related? Is an overview required, and do the existing structures (ABRC, ACOST, OST) provide it?*

The objectives of the Government funding agencies for the UK Science Base require strong overall co-ordination, since many of them are either overlapping or complementary, and in a financially-restricted environment, optimal use must be made of scarce resources. A fragmented approach without a clear overall strategy within which each Agency can pursue its own objectives could lead to inefficiencies, demoralisation of staff within the Science Base, and loss of highly trained staff by emigration or transfer to non-technological based sectors. Overall co-ordination may also prevent sudden changes of strategy or policy which are particularly disruptive to efficiency and morale. Nevertheless, the recently published White Paper has addressed this question.

The Association welcomed the establishment of the Office of Science and Technology and hopes that it will be given the chance to fulfil its potential. There is some concern within the pharmaceutical industry that the OST was not given, within the White Paper, sufficient overall control of many areas of the science base. The industry continues to be concerned over the fact that such a large proportion of Government spending is focused in the unscrutinized defence segment, particularly as this segment is resistant to the appropriate cross sectoral collaborative arrangements.

The new structures arising from the White Paper should provide a greater overview of the activities of the science base than the present structures have done. Recognition is given to the need for balance between "curiosity" research and research directed towards specific objectives. Both need to be seen against national priorities and appropriate provision made for them. Research activities of the science base should be encouraged into areas of national importance by the adoption of strategies, within the overall policy, which will set clear objectives.

We consider that the new structure has the potential for the fostering of science and technology in the UK and harnessing it for the future overall well-being of the nation. The "Technology Foresight Programme" should play a key role in determining the future needs of the UK in science and technology and the move to a rolling 5-10 year "Forward Look" is to be welcomed. The declared intention that the process should involve consultation with all sectors of the science community should be both welcomed and implemented. The reorganised Research Councils should be the main vehicle through which the necessary changes are brought about. However they will need to take account of priorities set within strategic objectives and adopt different approaches to project selection than has been the case in the past. In addition some entrenched existing inter-Departmental positions will need to be overcome if many of the proposals are to be fully implemented.

With regard to the responsibilities of the new research councils it is important to recognise that the fields of modern science and technology defy attempts at rigid classification and so boundaries are difficult to draw with any degree of certainty or precision. The new councils must recognise this, as must the Council for Science and Technology to be established under the White Paper. Thus although particular subject areas may need to be allocated to particular research council "pigeon holes" for convenience, the boundaries drawn must not be seen as set in tablets of stone and research which crosses boundaries between the new research councils must continue to be funded, and not rejected by each council in turn as being outside their remit. There is some concern from a pharmaceutical industry perspective that the splitting of biology/biotechnology from chemistry with the break-up of SERC may not be in our interest. (A note on this matter is appended—Appendix 1.)

The objectives of the research councils must not be seen in broad terms, as being dictated by either their titles or areas of responsibility. This would produce little useful change from the present situation. Each research council must have a specific, strategically important programme for which it holds prime responsibility. The new Director-General of research councils will need to play a vitally important role in relation to resource allocation within the national framework, and also in setting the missions and ensuring that where these cross research council boundaries it is seen as an opportunity for co-operation, and not regarded as cause to assert territorial rights. The Director-General must play a vital and central role in the future workings of the research councils and should also ensure that they are accountable for the mission responsibilities placed upon them.

We do not consider it appropriate to comment at length on what should be the specific objectives and priorities of the individual councils and funding agencies. We would, however, like to make some comments on aspects of the roles of the funding agencies.

The Association considered that the changes in funding structure that provided for the Higher Education Funding Council agencies to look after the infrastructure with respect to teaching, and for the research councils to provide the infrastructure for research was essentially a sound decision and, when the initial problems of establishing how this process will work have been resolved, should be essentially more productive than in the past. Certainly the dual support system has been abused, inadequately supported and eventually poorly understood by the various participants in it. It is essential however that the DFE accepts its responsibilities for providing the infrastructure for higher education, including buildings and research laboratories of an appropriate standard. Neither charities nor industry should be expected to provide higher education infrastructure.

The operation of the dual support system must be co-ordinated between OST and DFE, to ensure full support for a wide range of directed and curiosity-driven research. There must also be mechanisms for allowing a certain amount of speculative work which does not require full peer review at its earliest state, and some earmarking of funds at a local level to support such work is essential. This used to be done within Departmental funds in universities, but recent financial constraints have virtually destroyed any remnants of such funding.

Research councils should be able to fund a wide variety of endeavours within HE establishments, ranging from one-year pilot studies and three-year project grants through long-term programmes and guaranteed funding for units. In addition, a limited number of dedicated research institutes are clearly of value, although these must play an appropriate part in training scientists, and should be open to collaborative ventures with industry.

Post-graduate training has been the responsibility of the research councils through the award of PhD studentships, although both industry and charitable bodies have also played a role in this context. It is suggested that the mechanism of funding, and particularly the level of personal support for research students, should be critically examined in order to provide a better incentive for young graduates to take up careers in research. There could be advantage in regarding the post-doctoral period as continuing training, as it is, for example, in the fields of medicine and surgery. The research councils should consider providing funding on a personal basis rather than a project basis, allowing the post-doctoral Fellow to be free to continue his training in centres appropriate to his interests under the tutelage of experienced scientists. "Curiosity driven" research could be provided for within such a scheme and would provide a good basis for scientific development of the individual. The public funding agencies should have as an objective the provision of a trained scientific workforce.

The operation of the NHS research budget was given focus by the appointment of Professor Michael Peckham to head the newly-created NHS Division of R&D, and this is to be welcomed. The Association notes the recent publication of "Research for Health" and looks forward to further developments from this initiative. However, unless this activity is integrated into the Forward Look, and an effective degree of co-operation established between Professor Peckham's organisation, the MRC, through the Concordat, and other relevant bodies, including the pharmaceutical industry, a considerable resource of biomedical research capability will not be utilised to full effect. Since biomedical research (encompassing much of the activity of the pharmaceutical industry) has been so important as a springboard for wealth generation within the UK, integration of activities in this field between OST, the DoH and industry are essential.

The Association is firmly of the belief that the OST has the potential to ensure that synergy between the research councils and the higher education establishments is nurtured. This has not been the case between the various disparate bodies that attempted this function in the past and we view it as extremely important that a Cabinet level appointment now oversees science in the United Kingdom. The priorities of ABRC have been to allocate funds across the range of interests of the research councils. Arguably there has been a trend for ABRC to encourage science towards potential products, although their objectives have never been transparent. There are some within the industry who do not believe that this has been helpful nor that the ABRC has been sensitive to the needs of the research communities it is responsible for. The strategic view which it has taken in the past does not seem to have been closely aligned to the interests of scientists in the UK in either academia or industry.

We suggested, however, that none of the three bodies, OST, ABRC or ACOST has until now adequately addressed the major issue in the United Kingdom, which is that science and engineering are not perceived as desirable or important by the community at large. Science is important and valuable and rewarding as a career to the individual and for the country as a whole.

The answer to whether an overview of the UK science base is required is, of course, yes, and a mechanism has been provided in the White Paper. The test will be whether it works in practice, and whether the different objectives of the various Government Departments and research councils can be overcome to allow a co-ordinated approach to improving the support for and operation of the UK science base.

3. *What are the relationships connecting Government funding of the Science Base, funding by Industry and Charities, and overseas funding (particularly from the EEC)? Various people are "paying the piper": are they calling different or incompatible tunes, and if so is this a bad thing?*

Funding by industry can be divided into three categories:

(1) Contract research, in which a defined study is requested, with ownership of the results belonging exclusively to the funding company. However, such research should be charged at a full commercial rate to include all overheads.

(2) Collaborative research, where a more speculative study (albeit with clear objectives) with potential benefit to both parties is undertaken. This will often be at an early stage in a project, where there is no guarantee of a commercialisable end-product and there is considerable degree of risk. In such projects it would be expected that the company and Institute would share the Intellectual Property Rights (IPR) and some of the financial costs. Therefore the degree of overhead charged should be less than for contract research.

(3) Philanthropic donations, where a company wishes to support the Science Base in areas related to its overall strategic objectives, but with little or no control over the work done.

In recent years the universities have turned towards industry as an alternative source of finance for their research activities. This has brought advantages to both sides, but has also led to the development of tensions between institutions and industry. Industry must re-emphasise that funding of the Science Base by industry (and Charities) should not be seen as an alternative to adequate funding by the Government. Industries already contribute significantly to Government Sector Requirements via Corporation Tax, and should not be expected to provide additional funds for the Science Base infrastructure from their internal R&D budgets.

The increasing concern on the part of university administrators to ensure that industrial collaborators make a full contribution to the indirect costs ("overheads") of the project being sponsored is one example of this. Until recently the Research Councils and Charities paid no overheads in respect of the research they supported. Now, however, the Councils do contribute towards the indirect costs of projects within their grants, but to make this possible money was transferred to them from the HEFCs. The arrangement has had the effect of favouring those departments who are able to attract the project grants and removing seed-corn research funding from departments less favoured by the grant approval system.

There is thus a double standard being operated, with collaborative research depending upon who is the granting body. The work being supported is however often the same in nature and the academic has turned to industry because he is unable to obtain government funding for his project. In recent years certain establishments have attempted to increase this percentage to levels that are considered by industry to be inappropriate in view of the collaborative nature of the relationship and it has proved impossible in some cases to reach agreement and a project has not gone ahead.

A second difficult area is the ownership and exploitation of intellectual property rights (IPR) and provision of reward by way of Royalty payments. Academic institutions often now demand unrealistic IPR terms paying little regard to the context of the project and this has also led to support for research projects being rejected by industry. Industrial Liaison, or Technology Transfer, departments in universities, which have been set up to exploit the universities' science and engineering, often have little understanding either of the needs of the academic departments or the requirements of industry. There is therefore a tendency to develop dogmatic rules without regard to the difference between sectors of industry, and these have created barriers between the academic and industrial sectors.

The third danger which stems from this failure of public funding is the increasing tendency of academic institutions to see themselves as providers of services for industry, a trend which could result in compromising the nature of academic science and stifling creativity. These developments, which can create barriers between academic institutions and industry, are a result of government's underfunding for the basic infrastructure needs of modern science-based institutions. This is a priority which must be addressed urgently when considering new policy and strategies for the Science Base. However, we must recognise that the finances available for public sector science are not unlimited and that choices will have to be made. It is not necessarily the case that science needs greater investment of public funds, rather it may be suggested that better use of the funds currently available should first be considered.

The CASE awards have been widely used in our industry and provide a valuable means by which academic and industrial scientists can collaborate in research and training. They provide an opportunity for the academic supervisor and the student to come close to the industrial environment. The pharmaceutical industry will be monitoring very closely developments in this area since the future of the CASE scheme is not clear at present following the splitting of the SERC.

The LINK concept can provide for effective partnership between the three legs of UK science: industry, government and academia. Initially there were problems with the schemes which under the rules involved too many partners and resulted, in many cases, in less than optimum levels of industry/academic collaboration. However, the recent adjustments to the rules have focused on the good features of the scheme and now allow smaller groupings of academic and industrial partners to be supported. These have more potential for success than the earlier arrangements in which the industrial partners were little more than funding bodies. We strongly believe that LINK could be extended into other Government departments, eg the NHS.

The Association suggests that where there has been a real weakness has been in the inability of the pharmaceutical industry sector to input into priority setting or funding decisions of Government bodies. The White Paper seems to be moving to redress this balance, and we welcome initiatives in this direction. It appears that in many cases, although industrial scientists and managers participate in various Research Councils and other Government advisory bodies, they are often there as individuals in their own right rather than representing the industrial sector in an organised manner. Again, it is to be hoped that the White Paper may correct this situation. Also, industry representatives are often treated as observers, whose views may be seen as uninformed and of little value.

Funding by Charities usually is mission-orientated and is to support their own specific interests, particularly the medical charities whose constitutions restrict what can be supported. While it is very appropriate that the general public should be free to support whatever aspects of the science base they wish, it is of concern that in some areas the charity support is now seen as the only way to fund certain research, and that it is not possible to get support from Government bodies. If one includes the Research Foundations such as the Nuffield, Wolfson and Wellcome Trusts we now have the situation where in the biomedical areas the Charities are providing more support than the Government for research activities, much of it at the very basic enabling level. The Government appears to be allowing this funding to replace its responsibility for maintaining the infrastructure of the universities. This is totally inappropriate.

Generally the dialogue and collaboration between the pharmaceutical industry and the medical charities is seen as beneficial to both sides, with the industry often able to commercialise discoveries made possible by charity funding. More direct joint funding of projects would however probably be of benefit.

As far as funding from the EC is concerned it appears that the British academic sector is achieving the maximum that is possible given that the EC "cake" is cut 12 ways. It is arguable however that the cake should not be cut in 12 equal slices, given the various levels of scientific endeavour within the 12 Member States. To obtain funding through the EC is not simple and both industry and academia have found difficulties in dealing with the complex bureaucracy in Brussels. Efforts to simplify the bureaucracy and provide more realistic time scales for decisions is essential if funding from the EC is to make a significant contribution to the overall funding of the Science Base in the UK. Government effort to facilitate this process would be welcome.

In our judgement these various funding lines are available, desirable and seem to be complementary. The multiplicity of funding available to the UK science base has not led to overt incompatibilities. Such incompatibilities as do occur would not be seen by the industry to be particularly negative. The generally inadequate level of funding by the Government has meant that this multiplicity has been the saviour of much valuable research activity. Certainly from the point of view of the pharmaceutical industry it is our impression that there has been little problem with conflicting priorities between our own funding and that of other organisations.

4. *What information and advice is needed by those who are setting priorities? How do they know what is going on in current low-priority fields? How do they track developments overseas?*

The points raised in these questions have been addressed by the White Paper in its aim to create a framework in which UK science and technology resources can be employed to enhance wealth creation. Those making decisions about priorities for science and technology need to be informed about what the national requirements for science and technology are and should obtain this information from a number of different sources including government departments, public services, and industry as well as experts in fields such as academic science and engineering, medicine and economics. The most important point however is to define in advance the correct groups to be determining priorities, and only then decide what information and advice will be needed. The Technology Foresight Programme and also the Council for Science and Technology proposals both make provision for such advice to be obtained, for example, by creating foresight assessment panels made up of experts in important technology sectors. Such assessment panels can also engender collaborations between academia and industry and could bring about the application of new technology to strategic objectives in a timely fashion. We support this concept and look forward to its implementation. We must stress, however, that it is important that all bodies contributing to the Science Base, including the DFE and the DoE have policies and mechanisms for priority setting consistent with the OST. In this context we have concerns over proposals of the Department of Health to extend the Limited List.

Priorities can only be decided within an overall strategy, which must be clearly enunciated in sufficient detail to be meaningful and able to be translated into reality. This should include the total funding available for the Science Base, the balance between basic and applied research, the distribution between different disciplines, the relative contributions of HEIs and Research Institutes, and links with industry, etc. As indicated above, the Technology Foresight Programme should provide a framework to devise such a strategy.

For setting overall strategy it is important that all relevant bodies are consulted as equal partners, and not, as often happens, where one group has a dominant voice. In particular, industry has not always been adequately consulted, or its input considered. It has been suggested that scientific and technological industries which have been successful should have a bigger input to priority setting for the science base than those industries which have failed to adapt to technological progress.

In terms of specific areas where priority should be given, this requires information of several kinds:

(1.) What are the new scientific paradigm shifts which will determine the whole basis of research in an area for many years (eg the molecular biology revolution)?

(2.) What specific new technological developments are occuring which will enable hitherto difficult problems to be tackled?

(3.) Where is the Science Base in the UK deficient, and is the gap important?

(4.) What are the growth areas of science and technology where the UK can make a specific contribution?

(5.) Are there any major problems which must be tackled because of strategic importance (or even national importance)?

It is important that when priorities are set there is commitment from the groups and practitioners who will be responsible for implementing the actions. It is recognised that in any priority setting some groups and individuals will be disappointed. However, within the Science Base there must be an understanding of the processes whereby priorities have been set, and that vested interests have not been allowed to dominate. We must ensure that a small cabal of senior academic scientists do not dominate priority setting in a way which alienates the majority of practising scientists, as has been the case in the past.

"Low-priority" fields may be those which are involved with a highly specialised or esoteric area, where there appears to be little (or even no) wider applicability. While examples can be found of seemingly valueless research which has suddenly had a major impact, in a setting of priorities we suggest that it has to be accepted that some areas are so specialised, relative to others, that not supporting them has to be considered an option.

Other low priority fields may be those where new ideas are being pursued, the difficulty being to predict in advance which ones are likely to lead to important developments and which will be dead ends. Since this is the area where the breakthrough often arises, such areas need to be identified early, and sufficient funds put into those considered most likely to succeed. This requires specialised information firstly on what new developments are taking place, and then on the evaluation of their potential. These are areas where curiosity-driven and investigator-initiated research are the most likely ways of discovering what new developments are taking place, and what is then required is intelligent and informed assessment of which areas to support.

It will be necessary to select certain areas/ideas based on the best current evaluation, and then fund these fully, even at the expense of others which may have almost as strong a claim for support. An undesirable situation is to fund all potentially important ideas, but at too low a level for any to reach a critical point where larger funding can be justified. One must make a judgement to fund certain early high risk projects effectively, but understand that others which may succeed will not be funded, and not use hindsight to criticise judgements made on the best current evidence.

Developments overseas can be tracked in the literature if they are sufficiently advanced or part of a general world-wide activity. Where developments are less easy to track is in new technological areas where patents and know-how in specialised areas restrict the amount of information in the public domain. There are always individuals within the scientific community who have extensive contacts abroad, and can provide information on possible developments in other countries. Many pharmaceutical companies, because of the international nature of their business and location of R&D and Sales organisations in many countries, may have a better perspective of new developments than many other institutions.

5. *How do Charities and Companies which fund research set and implement priorities?*

It is our understanding that charities in general would have a restricted remit determined by their overall objectives towards understanding and curing particular diseases, and their priorities will be set within this. However it would be expected that they still would have to make decisions on strategy eg to fund academic groups or to set up their own units, as well as deciding between competing requests for funding. It is understood that many of the medical charities rely on applications from academics and clinicians (ie investigator-driven), although some research will be directed.

The pharmaceutical industry has for many years, recognised the need to focus its efforts into specific areas and priorities. In-house prioritisation takes many forms and can be very company dependent. All pharmaceutical companies will undertake regular reviews and planning exercises, to determine the overall objectives in terms of therapeutic areas, new technologies, and organisational structure.

Within the industry there has long been a clear recognition that it is not possible to maintain internal research in all areas in which potential therapeutic advances can be made. Companies have taken a variety of routes to maximise the benefit from their own investment in research. Some have invested in research institutes, others have established research partnerships with universities, and many have set up major research programmes, in-house, in focused areas.

It is important to note that a considerable amount of research and development within the pharmaceutical industry is not short-term, but requires considerable investment over a substantial period of years. In that sense it is much more akin to fundamental research than product development in a short cycle-time manufacturing industry.

In the pharmaceutical industry research is directed towards achieving the discovery and development of novel medicines for the treatment of human diseases. Factors taken into account in choosing a particular activity or research direction will include the probability of technical success and relevance, but in additon there will be an assessment of the commercial return and competitive situation.

A most important aspect of this is the acquisition of new knowledge concerning mechanisms underlying disease processes. Priorities thereof must be established on the basis of meeting the needs of companies' own strategic objectives. As indicated above there are some areas in which this process can be enhanced by external collaborations, which may introduce new approaches to therapeutic aims and which fit within the objectives of the various companies or open up new fields for future research. A good example of the latter is the work being undertaken within the human genome area.

The way in which policies and priorities for research are established and implemented will, of course, vary from company to company. What is essential, however, for industry in the development of outside collaborations is that government funding must be made available to ensure that the infrastructure of academic science is brought up to, and maintained at, a level that allows science and technology to be pursued to international standards, so that such collaborations are successful within the UK. The continued development of scientists and technologists within companies is also seen as important and is encouraged as a priority within the industry.

Where the pharmaceutical industry may vary from the public sector science base is in the ability to concentrate large efforts in a given area relatively quickly, and then to move onto other activities once the objectives of the programme have been achieved.

UNIVERSITIES

Although the pharmaceutical industry interacts significantly with universities we are not really in a position to comment in detail on the way objectives are set within HEFC funding. However it is noted by the industry that universities seem to accept the need to allocate funds by criteria that involve success and the needs of the UK generally. The Association commends them for this and suggests that it should be possible to provide increased support for those universities clearly able to provide a strong management structure within their organisation. It should also be said that as they have been inadequately funded to maintain their basic infrastructure, it has not been easy for the Universities to cope with this problem.

Further discussion is needed on a number of issues concerning HEFC funding, for example, should universities try to maintain all core disciplines at a reasonable level of staffing and research, or accept that there are some areas which cannot be adequately funded? We suggest that there would be major implications for other subjects (particularly as far as teaching is concerned) if a University did not maintain certain subjects. We would be greatly concerned, for example, over the effect on biomedical sciences if there were not a viable physics or chemistry department available.

The Association has considered the implications of the HEFC block grant being given in proportion to the amount of external funding, or in proportion to students being taught irrespective of research activities. The Association has noted moves towards an R-T-X model, and some of our Member Companies are uncomfortable with this process. It is accepted that Centres of Excellence benefit from well-funded, well-maintained infrastructure. There is some concern however that the development of teaching-only universities or X-type universities could restrict the bright individuals and their ability to gain support from the funding research councils.

7. *Research Councils*

The Research Councils all have some degree of funded industrial participation at all levels throughout their structure. The SERC has been the most pro-active in this respect. The priorities of the various Research Councils have been reconciled at the ABRC level, and these priorities have undoubtedly been constrained by the size of the Science Budget. There are some doubts that the review process has been adequately transparent. We look to the implementation of the White Paper to introduce positive changes in this area, including the increased involvement of industry in the decision making process. The Association has felt that it is important for the Research Councils to retain a mixture of types of funding, short and long term, and also maintain the mix between strategic direction set by the Council Boards and curiosity-driven research by individual investigators. Too much detailed priority setting is not, we consider, the best way to pick up on new developments. Boards and funding cannot contain all the expertise to know which specific areas are worth funding.

There appears to have been some confusion and opposition to the concept of mission research as outlined in the White Paper. In the context of the pharmaceutical industry and therapeutic research, it is important that the concept of "mission research" is seen particularly by the academic community, as covering a broad spectrum from basic research, such as the elucidation of the basis of human disease, through the developing of new technology to allow new molecules with therapeutic potential to be discovered, to the applied research needed to convert such compound(s) into safe medicines. A broadly similar model can probably be constructed to analyse R&D needs of other sectors of industry.

With the proposed splitting of the SERC and the establishment of a Biotechnology and Biological Sciences Research Council some concern has been expressed within the pharmaceutical industry that support for basic molecular biology research, chemistry and interdisciplinary research involving these disciplines will be affected. The views of the Association on this matter are appended.

8. *What is the pharmaceutical industry putting into the science base?*

It is difficult to put an exact figure on it, and the amount is likely to be variable, but the Association estimates that the pharmaceutical industry is putting some £35-50 million into the UK Science Base. This figure does not include the substantial payment for clinical trials, nor will it take into account the considerable capital investment in universities made by companies such as Glaxo, SmithKline Beecham, Wellcome, Parke Davis, Yamanouchi, Bristol-Myers Squibb. Most of the money put into the Science Base is for true collaboration, or for the support of training. The difficulties of quantifying the financial input are because it includes a wide range of activities including support for fully-funded units, fixed-term positions, specific contract work, consultancies, studentships, endowment of Chairs, charitable donations etc.

The pharmaceutical industry contributes considerable time and money to the training of scientists from the public sector within the UK. Numerous PhD studentships (SERC, CASE or MRC awards) are funded, and our members offer many positions for one-year placements for undergraduates. Pharmaceutical companies run school days at their facilities, and provide speakers on scientific topics for local schools. The Association has a full-time school education co-ordinator who provides an interface between the industry and schools, and who produces resource material of relevance to the National Curriculum and 16-19 education.

Many companies in the research-based pharmaceutical industry provide facilities for academic scientists to visit and carry out specific projects related to their own work. This is an intangible and unquantifiable contribution. In the current economic climate in which facilities in universities have been allowed to deteriorate the industry feels that it is making a major contribution in this area.

The Association also wishes to stress that the industry conducts much basic research itself which is published and presented at meetings, thus contributing to the general Science base of the UK.

9. *What is the pharmaceutical industry getting out of the UK science base?*

New ideas for future drug discovery and development programmes. Since any one company cannot carry out more than a very small amount of basic research, it is important to have multiple and close links with high quality research groups within the public sector. This allows companies to be aware of the latest developments in science, to use the academic scientists as consultants, and to bring the relevant expertise in-house if necessary. It should be stressed that this type of link is very important in determining where an international pharmaceutical company locates its R&D activities, and for the UK to remain attractive to the Pharmaceutical sector a high quality government-funded Science Base is essential.

Specific contract research, where there is particular expertise in the public sector for which the internal demand within the company cannot justify bringing it in-house. While this can be done anywhere in the world where the expertise resides, the ability for these studies to be done within the UK is seen as an advantage.

Highly trained staff at all levels, often with specific expertise obtained by working in world-class laboratories using cutting-edge technology. This is an area where considerable concern should be raised, since as the UK science base becomes less well funded, the graduates and PhDs being produced will not have been trained in or exposed to high-quality laboratories furnished with state-of-the-art equipment.

10. *Does the UK Science Base meet the expectation of the Pharmaceutical industry?*

In general the answer is yes, although it is clear that for some areas it is necessary to look abroad for expertise. However, it should be accepted that the UK cannot be expert in all areas, particularly in rapidly developing technologies.

Collaborations are usually satisfactory, and the attitude which used to prevail in academia of treating industrial scientists as being less knowledgeable or intellectually inferior has disappeared. In fact, owing to the general decline in the UK Science Base in the last 10 years, it is now accepted that the research carried out in the pharmaceutical industry is of an equivalent (or often higher) standard. It is very important for collaborations that there is mutual respect, and while the academic or institute scientist may be more knowledgable in the specific area (hence the collaboration), there must be recognition on both sides of the intellectual standing of each other.

The pharmaceutical industry in the United Kingdom has benefited considerably from the strong Science Base that was developed through the 60s and 70s. The erosion of this base began in the 80s and is now seen as a disadvantage to our industry but more importantly to the United Kingdom itself. The pharmaceutical industry is now global and the necessary disciplines forced upon it by increasing research costs allow it to assess the right place or the most sensible place to do research. The UK was in the position in the past to assume that it would be a Centre of Excellence. This is no longer so. Many European countries and certainly the US and Japan are competitive with our academic groups and we do need considerable effort at all levels to maintain the competitive strengths that were the characteristic of the United Kingdom.

The Association is optimistic that the proposals in the recently published White Paper will help the UK regain its competitive position. It is to be hoped however that there will not be too much of an emphasis on the carrying out of near-market research in academia.

The Sub-Committee has indicated that it does not wish to address technology transfer. We however, believe strongly that much of the failure of UK industry to capitalise on fundamental discoveries arising from basic research in the publicly-funded UK Science Base is a result of the lack of strong R&D tradition in many UK industries, rather than problems with the Science Base itself.

CONCLUSION

(1) The Association accepts that the amount of money available for support of science and technology in the public sector is not an unlimited resource and believes that it is therefore essential to make sure that it is used to best effect. This can only be achieved if national policies for science are generated, priorities are set and strategic missions established to ensure their successful outcome. It is to be hoped that this will be achieved by the framework as provided by the White Paper.

(2) The Research Councils must play a vital role in realising strategies for science and technology. They should encourage the building of partnerships with the government and private sectors of UK science. Existing schemes such as LINK and CASE can provide the basis of intersector understanding and collaboration and should be built on.

(3) The pharmaceutical industry has a key part to play in the support of UK science and technology, both in terms of intellectual contributions and also the provision of funds. Barriers that come between industry and academia, and which prevent openness and partnership, must be removed.

June 1993

APPENDIX 1

IMPLEMENTATION OF THE WHITE PAPER ON SCIENCE, ENGINEERING AND TECHNOLOGY

INITIAL VIEWS OF THE ABPI ON THE IMPLICATIONS FOR THE FUNDING OF BIOTECHNOLOGY

The White Paper states that:

(i) *"The Biotechnology and Biological Sciences Research Council will, to a significant extent, combine the current work in these fields of the Science and Engineering Research Council with the current responsibilities of the Agricultural and Food Research Council. The new Council will be expected to develop close links with biologically based industries* ***outside the medical and health*** *and environmental fields, . . ."*

(ii) *The user communities of the Engineering and Physical Sciences Research Council include: "engineering, process, construction, chemical information technology, electronic, electrical and communications industries, . . ."*

There is no reference to the pharmaceutical industry, but this is assumed to be an oversight.

(iii) *The user communities of the Medical Research Council include: ". . . medical instrumentation,* ***pharmaceutical, biotechnology and food industries. . . ."***

From this it will be noted that the pharmaceutical industry is a user community for the three main research councils. The omission of the pharmaceutical from the Engineering and Physical Sciences Research Council is presumably an oversight, but this is indicative of the heavy emphasis likely to be placed on the physical and engineering aspects of the Council's future funding proposals.

There is some concern within the pharmaceutical industry that because of the transfer of biotechnology to the existing AFRC structure, the new Biotechnology and Biology Research Council (BBRC) will have an agricultural and food bias, much of it applied. There is a marked contrast between food industry research and medicinal research. To date the investment in research in the food industry has been minor, purely product directed (not that that is necessarily a bad thing) and apparently focused on products in which the turn around time has not been more than two years.

This ethos is, we suggest, totally at odds with that relating to medicinal biotechnology, and difficulties are foreseen in how the two philosophies can be handled in one Research Council. As was stated above the new council will be expected to develop links with industries outside the medical fields, thus appearing to confirm our concerns that the council will be food biased.

In addition, the industry has further concerns that fundamental molecular biology may be squeezed, or be seen only as the province of the Medical Research Council, ie a part of the Human Genome Project. However, there is much molecular biology of general relevance not limited to either food production or medicine, which we consider must continue to be funded by the new Council. If the UK is to maintain its position as an important scientific nation we must increase funding in fundamental molecular biology, and not have all the work seen as only of interest in the applied areas of medicine and agriculture.

In the past there were occasions when applications for biotechnology funding were passed between the MRC and SERC. The last thing we want to see under the new arrangements are squabbles developing between the BBRC, MRC and the EPSC over biotechnology funding.

In the important field of biotransformations funding could easily slip between two Councils. Much biotransformation work is focused around enzyme and fermentation technology, and, we anticipate, will probably be funded by the BBRC without too much trouble. However, once specific chemical reactions are mentioned in an application there is a possibility that funding applications would be passed to the EPSC, who may have little support for the biological emphasis on the technology even if the end products are chemicals.

It is the previous experience of the pharmaceutical industry that funding applications submitted to one Council, but passed to another, failed the first time because of differences in what each council wished to see emphasized. Arising out of the on-going inter-Research Council discussion on this topic, the industry hopes to see clear guidance arising for applicants as to which council to apply to, but also as to what emphasis needs to put on, eg techniques *versus* applications. The new Director-General of the Research Councils must insist on no territoriality issues, and an applicant for funding should be guided to the appropriate body easily, with exchange of applications between councils being transparent. We suggest that a uniform application form for all Councils should be the first priority.

In addition, as mentioned above, we would not want to see the situation developing of applications being shuttled between Councils merely because they cover interdisciplinary topics. We would like to suggest, as has clearly been demonstrated by the pharmaceutical industry, successful research and development requires an inter-disciplinary approach, and the new Research Councils must be fully aware of this in their attitude to cross-boundary applications.

Despite the comments above the pharmaceutical industry considers that with the appropriate audit mechanism in place, and with appropriate input from senior industrial and academic researchers, the funding of biotechnology will eventually fare well under the new arrangements. There is much concern, however, that the funding of *chemistry* is likely to be under some pressure. The pharmaceutical industry firmly believes that the present level of funding for chemistry should be maintained, or even increased. There is a possible danger that the physical and engineering parts of the EPSC will dominate the funding to the detriment of chemistry. Chemistry continues to constitute the major proportion of the research, development and production activities of the pharmaceutical industry. At the research stage the activities often described as biostructural and bio-organic, ie protein crystallography and n.m.r; molecular modelling and drug design clearly fall under the auspices of medicinal chemistry in addition to the more classical elements of organic synthesis and structure-activity relationships. Appropriate mechanisms need to be implemented to ensure that such fundamental work continues to be adequately supported.

The pharmaceutical industry looks forward to working with the Director-General of the Research Councils, the Office of Science and Technology, and the Department of Trade and Industry to help ensure that all parties appreciate and overcome the specific potential problems of the proposed changes to funding at the chemical/biosciences interface.

APPENDIX 2

THE POSSIBLE EFFECTS OF THE LIMITED LIST OF MEDICINES ON R&D IN THE UK

The White Paper indicated that the Office of Science and Technology is to have a hand in shaping the policies of *other departments* as they involve or affect R&D. The Association has been asked how we would like to see this new influence applied in the short term, for instance, in respect of the Department of Health's new Limited List of prescription drugs?

Correspondence on this matter between the Association and the Office of Science and Technology is attached. The Association would clearly like to see the OST urge the Department of Health to take on board the concerns of doctors, patients and the industry and withdraw the Limited List.

Letter to Professor W D P Stewart from Dr J P Griffin, Director, ABPI

At a meeting with the Association's Science and Biotechnology Manager, Dr Jeff Kipling, you raised the issue of the proposed extension of the Selected or Limited List and asked for a note on the R&D implications of this for the pharmaceutical industry.

The Department of Health's proposal is to extend the restrictions imposed by the Limited List scheme from the existing seven therapeutic areas to a further ten categories; anti-diarrhoeal treatments, medicines for allergic disorders, hypnotics and anxiolytics, appetite suppressants, medicines for vaginal and vulval conditions, contraceptives, medicines used in anaemia, or preparations acting on the ear, nose and skin and topical anti-rheumatics.

Prohibiting the prescribing of current available treatments will have a serious impact on the British research based pharmaceutical industry both directly and indirectly.

The precise direct effect of the extension of the Limited List into these ten further categories is difficult to quantify with accuracy at the moment since the Department has been economical with the details of their proposals and how they will affect specific products within the new therapeutic categories indentified.

The industry has therefore had to operate on a worst case scenario. The Department proposals could affect as much as £450 million of sales annually to the NHS or one in five prescriptions issued. This will mean that, based on an average investment in research equal to say, 15 per cent of sales, there must inevitably be a reduction of about £75 million invested in research. Future research depends on the income of sales derived from current branded prescription medicines.

In the ten therapeutic categories identified by the DoH for extension of the Limited List 190 UK research projects are in progress, all of which could be put in jeopardy. Past experience of the original Limited List shows that restricting availability of medicines imposes a blight on research and innovation. In a reply to a Parliamentary Question by Mr Tam Dalyell, the Minister of State for Health stated on 26 November 1992 that since the implementation of the original Limited List proposal in 1984 only three new products had been marketed in the UK in these seven therapeutic areas. If this pattern of experience is extrapolated to the newly-announced ten therapeutic areas then it is likely that all the 190 current projects will be abandoned and no new projects initiated, ie therapeutic research and therefore progress in these areas will cease.

More importantly, loss of sales will affect the ability to fund research in general. This means that the impact of loss of revenue will have an immediate "knock-on" effect in areas of research *not* covered by the Limited List extensions. Investment confidence will be undermined and new investment in research and manufacturing plant will go overseas.

Of course, it is inevitable that major investments already underway such as the Glaxo investment at Stevenage, will be completed, but these projects were initiated in happier times and are not likely to be repeated.

It is also difficult to give any firm indication of job losses flowing from these DoH proposals, which are so cleverly made as to be non-specific. A worst case scenario, if it is of any help, would be in the region of 5,000.

As Britain's leading high tech industry, the most serious impact of these proposals is the loss of industry confidence in the Goverment. Before the last election Conservative Central Office was specifically asked by the American pharmaceutical companies whether there would be any extension of the Limited List and were given a categoric no.

At a time when economic difficulties beset British business generally, the pharmaceutical industry has remained uniquely successful, largely as a result of the commitment and success in research and development and it would be disastrous if the Government, in seeking to achieve short term savings in health spending, damaged one of the UK's most successful industries and the effect of that blight would last for decades.

Examination of witnesses

DR P DOYLE, Executive Director, Zeneca Ltd, and DR DAVID GIACHARDI, Director, Courtaulds plc, from the Chemical Industries Association; and DR A W SIM, Director, Scientific Development Group, Organon Laboratories Ltd, DR M ELVES, Director, Scientific Affairs, Corporate Policy, Glaxo Holdings plc, and DR P J ENGLAND, Director and Vice President, Cellular Biochemistry UK, SmithKline Beecham Pharmaceuticals, from the Association of the British Pharmaceutical Industry, were called in and examined.

Chairman

729. Gentlemen, thank you very much for coming to see us. Who would like to start?

(*Dr Sim*) I have one or two things to say. Perhaps more than most other industries the pharmaceutical industry is critically dependent on the public sector science base both for generating new scientific and technological knowledge and for the provision of well-trained scientific and technical staff for R&D activities. The ABPI, which our group of three represents through its Scientific Committee, welcomes the opportunity to produce evidence to this enquiry particularly as it comes, as you have said, so soon after the publication of the White Paper. The first question you posed was what is our verdict on

[Chairman *contd.*]

the White Paper on Science, Engineering and Technology? I think there would be several opinions around the table on this. I might just start by saying that I think the opinion of the ABPI in general terms would be that the White Paper says the correct things. It looks to have many of the things which the pharmaceutical industry has asked for in the past in terms of a general overview of science. These things are all in the White Paper. I think the reservation which we might well have is will this be carried through into practice? I think we would therefore, in the first instance, reserve judgement on the White Paper until we see how it is going to be carried through. There are some specific items within the White Paper which I think perhaps some of the other members of the panel would like to comment on.

730. Perhaps we will leave the detailed points until we have established what the general view of it is.

(*Dr Giachardi*) Can I speak on behalf of the CIA which Dr Doyle and I represent. The CIA is is a leading organisation within the chemical industry and our position on the White Paper is one of broad support, but concern about some of the details which we can talk about later. We think it is very valuable in that it has brought the issue of science into public debate and that is actually a very valuable contribution. We have some strong reservations about some detailed aspects, which we can talk about later, but I would share what the ABPI is saying, that a great deal now needs to be done in implementation; it is only a first stage.

731. We need to see the machinery?

(*Dr Giachardi*) Exactly.

732. One of the pillars on which the whole thing rests is the idea of partnership with industry, once again after so many years. What do you think that might mean in practice in your own sector?

(*Dr Elves*) My Lord Chairman, before we address that may I say that we would warmly endorse what David has said. I think what is particularly welcome to those of us in industry who are interested in research is the very overt recognition at Cabinet level of wealth creation through innovation and the recognition that innovation rests on science and technology which in turn derives from investment in R&D. I think that process, all the way through from linkage in R&D to wealth creation and manufacturing, is very important indeed and I think making that explicit in the White Paper is a very important step.

733. Let us talk about this partnership idea. What does it mean?

(*Dr Elves*) Can I address that, my Lord Chairman, from the point of view of the pharmaceutical industry which has got a long tradition, of course, of partnership with academia, particularly within the biological sciences. We are also dependent, of course, on the public sector science base for provision of sound and well-trained scientists and technologists for our own laboratories. For a long time we have managed to be successful as a result of our own efforts in-house for a number of reasons. One of them is that the diseases with which we have been largely occupied and have been successful in obtaining, if not cures, then ameliorative therapy, are the diseases where animal models readily exist and therefore we have got a test bed that gives us a degree of confidence in the molecules we are looking at in order to take them into the clinic. We are now entering a new phase in the pharmaceutical industry where the challenges that lie before us now are a set of diseases which are important from the point of view of society as a whole, but which are increasingly difficult for us to come to grips with because they are almost uniquely human diseases. I am thinking particularly of diseases like osteoporosis, which is ultimately likely to affect up to 50 per cent of the human population, yet we have very little in the way of ideas as to where to start looking for new treatments. It is still guesswork and, to be blunt, a bit hit and miss. The treatments that are around are by no means optimal; they are second-best. We could do better if we understood the cellular, molecular mechanisms underlying bone deposition and remodelling and what goes wrong with those mechanisms in the osteoporotic patient. Rheumatoid arthritis affects a very significant number of people and yet we are no nearer forward towards a cure for that condition, as opposed to symptomatic treatment, than we were 25 years ago; and this is despite a considerable amount of money and time which has been invested in understanding basic immunology. We are now very well informed about the immune system of the mouse, but we still have not the first idea really of what the real defect in rheumatoid arthritis is. Senile dementia is a disease which is becoming increasingly common and a major health problem, and also a major social problem, for our communities. We have not any real confidence yet as to what the underlying cellular and molecular basis of that condition is either. If we are going to start to make inroads into these conditions, it is essential that we are come into very much closer partnership with our colleagues in academia, particularly those who have access to the patients who are actually suffering from the disease; and the multitude of disciplines that allow us to study those diseases in a way that is realistic. We cannot biopsy the brain, therefore, we have got to have non-invasive methods to look at the human brain and to find out what is going wrong, in pharmacology terms, in the Alzheimer's patient, in the schizophrenic or the depressed. I think this partnership is something that is going to become increasingly important. We are going to have to work much closer with academia than we ever have done in the past and, having said that we already have very close connections, but the academics themselves are going to have to develop partnerships with other academics; that is something that does not always happen. So pharmacologists are going to have to work with molecular biologists, they are going to have to work with physicists, they are going to have to work with clinicians, and that too, to my view, is where this concept of partnership has got to be moving towards. If we do not actually achieve that, then we are not going to move forward in many important disease areas where we should be moving forward. That in turn will mean that we are not producing new drugs for important conditions, and that will affect our profitability, and of course earnings, for the United Kingdom as well.

Lord Butterworth

734. You are saying that in your applied pharmaceutical field in order to get on, in order to find drugs, in order to advance your problems, you are reliant upon further work being done at the basic level by the basic scientists. Now, this does suggest two things to me, one, about how priorities are organised in basic science and, therefore, using this word "partnership", what kind of communication there is between you and the basic scientist in order that he can know what your problems are and what further work in basic science is needed in order to unlock your problems. Have I got that right or not?

(*Dr Elves*) I think, my Lord, that is absolutely correct, yes. We do not regard as necessarily helpful the classification of science into basic science, at one end of the spectrum, and applied science at the other. In our field, in our business, we talk, or should be talking, much more about mission-orientated research which will cover a full spectrum from enquiry at the one end through to the application and drug development at the other. How does the academic or basic scientist come to understand our needs? That can only be done of course through the development of close relationships with academic groups. We have significant numbers of course of "basic scientists" in our own laboratories too who are part of the wider science community and have got contacts with their fellows in academia and in research council-funded institutes, and this network is a communication network. What has to be done, I believe, is that that network has to be broadened so that, for instance, people outside of the immediate disciplines are made aware of what the problems are. The physicists ought to be brought into the picture to improve methods of imagery. The pharmacologist needs to help the physicist to understand how he can bring the compounds he has at his finger tips to provide the image.

Chairman

735. May I just ask you, you have not mentioned where responsibilities lie in this partnership with industry. You have talked about what the academic scientists should do, and I quite agree with you that is what they should do, but who is responsible for what?

(*Dr Elves*) I think the answer to that, my Lord Chairman, is that the programmes must be set up in an orderly and structured way, preferably through the relevant research councils, and by organising the scientists into teams multi-disciplinary, multi-sectional, multi-sectorial teams—and managed by a programme manager. This has worked quite well in our experience with some of the LINK programmes, for instance, where some of the small ones have been very successful in bringing about exactly this degree of synergy which we would like to see extended elsewhere.

736. But would you see your company and companies like yours putting money into it?

(*Dr Elves*) Yes.

737. And taking part in the organisation of it?

(*Dr Elves*) Yes, I think it is incumbent on us to provide financial resources as well as intellectual input.

Lord Dean of Beswick

738. You mentioned, I think, three or four very serious illnesses which take a terrible toll. Perhaps as a lay person I would opt for Alzheimer's as perhaps being the most distressing disease of the lot seeing the toll it does take on people now and it seems to be in an increasing manner. You were saying that in those particular four there has not been much progress made or not as much as you would have liked. Could I ask you, if you were to opt for a priority amongst the four, could you have got a lot further by giving one a definite priority?

(*Dr Elves*) I think undoubtedly with more focus and more managed research and more concentration of research effort in any one of those four conditions, we could have seen more progress than we have done.

739. Who would decide the priority if you are to have one?

(*Dr Elves*) I think this is part of the new framework which is being set up by the White Paper, and I would see the Forward Look as an absolutely critical part of that machinery.

Lord Dainton

740. From what I have heard, the impression I gain is that all of you are interested in what one might call molecular science, that these processes are at the end of the day, whether in industry or big chemistry or whether at the pharmacological end, all involved in chemical change. Yet curiously chemistry never appears in any of the new research councils and yet it is evident to me that it permeates the work of all the research councils to a very considerable degree, whether it is agriculture and food research, or medical research or obviously the new engineering and physics and so on as well as the biological one. The problem seems to me that if you start subdividing the whole area you then are erecting barriers between departments and you are then making it possible for a large subject like chemistry, as it were, to disappear from proper overall consideration. What are your views on that? Is that right or is that wrong?

(*Dr Doyle*) I think that is a potential danger but I think I would take comfort from the fact that it has been well-expressed before, particularly in the Royal Society of Chemistry's contributions to the Stone Committee, that chemistry is a very pivotal subject and as evidence of that I would point to the way biology is being put onto a very chemical basis. I think there is a wide acceptance in physics and in material science that chemistry, *per se*, is an essential discipline and as such is likely to feature in the funding of a number of research councils. I think it is of secondary importance that it is not mentioned because I think we regard it as one of the physical sciences and therefore to that extent it is represented. I think I would say from the point of view of manageability there have to be practical divisions between research councils and provided there is a proper and real role in the new structure generally the issue that worries us that chemistry will fall between two stools should not happen. In fact, we believe the very reverse should happen, that a number of reasonably definable areas of chemistry should quite naturally be seen to be funded within the purview of the engineering and physical sciences group. Equally

[Lord Dainton *contd.*]

there are areas of, for example, environmental and archaeological chemistry both of which are receiving much more attention than hitherto which should fall into the NERC. Particularly important for the groups here today, who have a particular but not exclusive interest in things like pharmaceuticals and related bio-organic chemistry, is that there is appropriate funding within the new B&B Research Council because if you look at the customer bases that all of them serve, at least three research councils take a proactive interest in chemistry.

741. One can say of these research councils, their mission having been defined, this is the customer pool of the subject of chemistry as a whole and we all know that there are areas of chemistry which might therefore not be noticed which will be terribly important in the future. How do you take care of those?

(*Dr Doyle*) That is when I see the partnership coming into play because I really do believe that there should be (and the intention I think is laid out in the White Paper) a proper influence, perhaps an increasing influence, of industrialists and I think in this case we are not looking necessarily for the most senior industrialists but active research industrialists who really do know how the fields are developing. They should be offered a more active part in the research councils and through first the Foresight exercise and then the Forward Look their influence should be brought to bear on this broad programme and within the programme, the priorities. I think we are going to have to watch nationally that we do not fall into a trap of having a Bernalist, centralist view of science and trying to plan it as if it can be done in infinite detail. I think we have to get to a certain level of detail; we need to go beyond the level of broad technologies. I think somewhere at the secondary level you then have to stand back and say, "These are the priorities and the guidance given to the research councils and this is the funding that is allocated, now you really have to use that in a way which is consistent with this guidance."

Chairman

742. The new terms of reference of the research councils are all emphasising wealth creation, are all emphasising the applied rather than the basic (or rather than the pure anyway). Given that the sum of money available is fixed more or less it would seem to me that if there is more emphasis on applied it is at the expense of the pure or the expense of the curiosity-driven. Is there not a danger that if one has too much industrialist-led the curiosity-led goes out of the window?

(*Dr Doyle*) I think there is a very real danger of that and I think that all of the replies which were made from companies or associations have actually pointed to the fact that what we are talking about is much more inherently exploitable science, mission-orientated science, and we have used that term quite deliberately as distinct from applied research which many of us see in Frascati terms as having a very specific connotation. I think we have been careful to say two things. While we want an industrial influence, we do not want an excessive one that drives everything towards very close to market, very applied research. What we want to see is that the research topics actually reflect exploitable science and the balance of the science between fundamental, strategic and applied will depend on the state of the art—if you will allow me to use that term in respect of science—in that particular discipline. So we are very keen that we do preserve breadth. I think all of us are very keen not to follow the ACOST line of setting basic science apart, because we see science as a continuum and so we are very keen to see within any main area the whole spectrum of science pursued.

Earl of Selborne

743. On the face of it if industrialists are encouraged or required to take greater part in the determination of priorities because they can perceive what the end product might be or think they can perceive what the end product might be, it would suggest that their priorities would move more towards the applied sector. We have had evidence earlier, I think it was from an industrialist, that they were expecting things to be quite different and companies might well be capable of determining for themselves how to conduct their applied research but they are looking for the science base to be funded by government. I wonder whether any one would like to comment on that, whether the feeling that applied research is going to result in a more mission-orientated approach is correct or not.

(*Dr Giachardi*) I would agree with what Dr Doyle has said; I do not think the emphasis will lead in a direction that people will become concerned about because most industrialists can identify that which is better done by industry and that which is better done in the academic sector because they are different. What we would be concerned with is if there were a drift by universities to being over-dependent on industry. That would be wrong. There is the spectrum Dr Doyle was talking about. I think we can see where the balance is. I do not think I would be too concerned from an industrialist's viewpoint.

Chairman

744. We are pushing you on the point you make yourself that a "lack of strategic support for public sector science which underpins the research activities of the chemical sector" is something that you are concerned about in the CIA.

(*Dr Doyle*) I think you asked what we would like to see in the partnership. There is a danger of complacency here I know but I think in the chemical-related sciences which embraces the pharmaceutical industry, agriculture and agro-chemicals and the whole spectrum of effect chemicals, we have never seen a great divide between academia and industry; we have seen partnerships. I have never felt that my academic colleagues are in ivory towers. In fact, they have pushed towards me more projects for collaboration than we can handle. I think that there is a fundamental problem of the United Kingdom we might touch on. There is something in the British character: when they see something that is working perfectly well, there is a dangerous tendency to undermine it and pull away support. One of the things it is very important to say on this partnership is, "Please do not weaken it; it is important that we

[Chairman *contd.*]

sustain things that are strong." We need to complete the work. If you want evidence of that partnership I think the Royal Society and CEST have particularly well-informed views on that because CEST have made a particular study on the area and they do single out the chemistry-based scientists as having particularly good partnerships. I think it is important when the cake is finite—and we will come down to how the cake is cut; it always comes down to that in the end—one of the most important messages we can put in from the wealth creation point of view is: "Please recognise the importance of this pivotal area (chemistry) and do nothing to undermine it." If anything, you should be seeking to strengthen something which is an effective paradigm. That could be taken up by two groups: other industrial groups, dare I suggest; but more importantly the small and medium sized companies that do not participate in the way the companies represented round this table do. That is one of the fundamental weaknesses that will be more exposed if we successfully implement what is in the White Paper. It is one of the things that distinguishes us negatively from Germany, the lack of what is known as the *Mittelstand.*

Lord Dainton

745. If it is a weakness, how do we then deal with it? How does one get to the small manufacturing enterprises which do not know their own needs very often?

(*Dr Doyle*) And do not believe in technology investment.

746. Yes, what can be done through the White Paper? Is it for Technology Foresight to identify them and then work with the DTI or is there some other solution you have?

(*Dr Doyle*) I think it is much more long term than that and the White Paper might pinpoint it, but it is not the mechanism for solving it.

Chairman

747. But we are in danger of having a slightly paradoxical situation, I think, because, on the one hand, you say we should support that which is strong, and amongst the university chemistry departments there are certainly some very great strengths but not in everything, and, on the other hand, you are saying that we should try to guide strategically at any rate basic research towards things which in the long run would be of importance to industry. The things that happen to be good in chemistry departments are not necessarily things which in the long run will benefit industry, unless there is some oversight and influence at work. Can you deal with that paradox?

(*Dr Doyle*) Yes, I think because, remember, we look for two things. I think probably at the top of the list comes the supply of highly-qualified trained people, particularly in research methodology. We have always put that, I think, at the top of the list and very close behind, perhaps first equal, is enabling knowledge and advancement in science, but we always put these as the twin purposes, we see, of investment in the science base. So even if all of the science is not inherently exploitable or immediately exploitable, we actually believe that it, nevertheless, provides a valuable training.

Lord Dainton

748. One of the proposals within the White Paper is for a four-year PhD starting with an MSc course. Does that strike you as a sensible thing or should it be left properly in the hands of the universities and the professions?

(*Dr Giachardi*) One of our concerns about the White Paper is that we feel that the Masters degree, as described in the White Paper, has not been fully thought through as to how it fits into the overall system. What we would be looking for is as wide a range as possible of choice for education and training at tertiary level because you clearly need different skills and training for somebody who is going into research in a pharmaceutical company from somebody who just wants a general background in science for working in a technically-based industry and somewhere half-way in the middle you have somebody who is, let us say, going to do a technical job in a production plant. So we would look for as wide a range as possible of degree courses and subsequent training and we feel that the Masters on its own has not been fully thought through. That having been said, I do welcome the emphasis in the White Paper on expanded public understanding of science, but what it does not mention, in my view, is enough emphasis on good teaching of science all the way down to the school level which is a serious problem at the moment.

Chairman

749. The Technology Foresight proposal of the White Paper, do you think that that is valuable and, if so, what would it consist of in your view and how would it influence you or how might it? How should it be directed so that it does?

(*Dr Elves*) The Technology Foresight programme, I think, could be an enormously valuable asset to United Kingdom science and technology. On the other hand, it could simply become occupational therapy for certain groups. It is very important that the Technology Foresight programme is arranged and the best possible panels of scientists and technologists are put together in each of the major areas of science and technology so that they can actually go out and assess not only what is available out there, but how it could actually be utilised back at home within United Kingdom universities and United Kingdom industrial laboratories. It could easily become stamp-collecting, collecting new technology and just because the Japs or the Germans or the Americans have got it, we would rather like to have it too. I think if it does that, then it will have failed. The other important aspect of the Technology Foresight programme of course is that if it is going to be valuable at all, it has got to be broadcast so that the wider scientific and technology community must become aware of what the technologies are that are being identified outside and their views sought on its utility.

750. Is it an activity that you would consider putting a lot of your own money into?

[Chairman *contd.*]

(*Dr Elves*) From our company's point of view, we already do. We have now got several strategic alliances set up across Europe, but mainly in the United States, which are designed to do just this; in other words, exploit new technology that our own scientists have spotted out there, and believe could be useful in the long term for our own drug discovery programmes. So yes, we have done this, and I think other companies within the industry also do this.

751. We know that the chemical and pharmaceutical industry are somewhat ahead of others in this country in this sort of way. Do you think there are lessons to be learned by other kinds of industry, the more physically based ones?

(*Dr Elves*) That, my Lord Chairman, is very difficult for us to answer as we have no real experience of other industry needs. I think that it would certainly be worthwhile other industries taking a look at what is happening elsewhere, and if it fits to take it up. I think if they did that critically, they could well find, I think, that Technology Foresight could be important for them too.

752. Have other industries ever come to you and said, "How come you are successful and we are not?"?

(*Dr Elves*) Yes.

(*Dr Doyle*) Yes.

753. What do you tell them?

(*Dr Elves*) That is a question we often cannot get the answer to.

(*Dr Doyle*) If I may say, my Lord Chairman, one of the attractions for the other industries of this sort of programme is that if you actually set out to survey new technologies in particular industrial sectors, one of the things you inevitably would do is bring together key people in those industries and in the academic community. The actual process, I think, of examining options in that particular area of science or engineering would actually bring them hopefully to some community of purpose; either that or it would actually endorse the fact that there are serious divisions which have to be bridged, but I think the process of looking at the top technologies which are of mutual interest can be nothing but beneficial. I think it would be, dare I say, an exercise well worth doing in some of the industrial sectors that do not seem to have the sort of relationship that we enjoy.

754. As far as the Foresight Programme is concerned, what would you like us to say to the OST?

(*Dr England*) One of the things, my Lord Chairman, is that we must have sufficient input from our industries into the relevant bodies in the Foresight. We must use the expertise we have got. One of the advantages the industries represented here have is the large number of highly-skilled personnel who have up-to-date knowledge which allows us to interact fully with the science base. It is actually one of the things that characterises our industries over and above a lot of others. The sheer amount of resource that we spend on R&D, the large number and the quality of the people we employ, the esteem, and since we are all R&D people I am boasting a little bit here, but the esteem in which R&D people are held within our industries means we can have a big influence in terms of input into the science base. I would like to see the relevant people from our industries having an appropriate input in terms of fitting the Technology Foresight into the overall view of how the money gets spent. We must not be seen as a peripheral area, which provides a small input, but it is important that we as a group of industries have an appropriate voice into the Foresight Programme.

755. How is this operation actually going to take place? I have a vision but I am not terribly happy with it of a large number of youngish chaps sitting somewhere or other in Whitehall beavering away having foresight and consulting people like you as seems fit from time to time in order to assemble their paperwork. Now that is what has happened in the past when people have tried to survey fields. How is it going to be this time?

(*Dr Elves*) I think, my Lord Chairman, the scenario you paint is an horrific one and if that was going to be the case I think we can forget about it as being at all useful, but if the scientific and technological community, which is actually involved in the process, are active research workers, they will meet up with these technologies in their travels around the world (through conferences and things of this sort because these are often very fertile grounds for picking up new ideas and seeing what others are up to), and then bringing them in for a broader analysis than is presently done. The tendency at the moment is to be inward looking, to keep the information to yourself in order to promote your own little corner. I think we need to change attitudes so that does not happen and that the insights are brought into the science community as a whole and made more broadly available for comment and evaluation. But sitting at a desk in Whitehall, no.

Lord Dainton

756. We saw this problem, of course, in the early nineteenth century. When the University of Berlin was founded in 1812 it said you must have dual appointments in sciences and applied sciences in order to get a diffusion of knowledge both ways and therefore develop a kind of congruence on what is important and what is unimportant for two purposes, one is the basic end and the other is the applied end with a lot of exchange appointments or joint appointments. What is the reaction of British industry to that proposition? It is not mentioned in the White Paper.

(*Dr Elves*) Again, my Lord Chairman, that is an excellent way of cross-fertilisation but unfortunately it is not part of the United Kingdom academic tradition.

757. Traditions have to begin somewhere.

(*Dr Elves*) That is right. There are traditions and there are bad habits. The lack of joint appointments is a bad habit we have got into which has to be broken. In our company I doubt if we have more than five people who have visiting professorships. That is not because there is a reluctance on the part of our senior scientists in giving time to developing relationships; it is often the other way round, a reluctance of the academic community to recognise the scientific worth by giving individual Scientists these titles. It is not something encountered in

[Lord Dainton *contd.*]

Europe where there is a much more open network of relationships. The way we address this problem is by establishing collaborative research projects and also, particularly valuable, collaborative PhD studentships based on the CASE system which allow academic and industrial scientists to come together in discussion and in actual collaborative work, sharing equipment, sharing ideas; and not seeing the industrial sector as simply being an extension of the grant awarding authorities. That we find is quite successful. It makes up for the deficit and we now have getting on for 200 or so of our senior scientists who are actually involved in some way in project work with academics, and the academics coming in-house as well.

758. So perhaps when setting priorities one should, in fact, encourage links of this kind and then the situation will largely take care of itself?

(*Dr Elves*) Yes.

(*Dr England*) My Lord Chairman, for clarification, are you actually thinking of secondments for six month periods rather than the type of interaction referred to by Dr Elves?

759. No. Something I noticed when I was at Nottingham is that we would take the Chief Scientist of Rolls Royce at Derby for one day a week and pay him and he would be involved and take part in the work of the Department and the Faculty and vice versa.

(*Dr England*) That does not happen at the moment. I have a visiting professorship and I currently merely visit the University and give a few lectures.

760. But you do not supervise anybody working there?

(*Dr England*) No, I do not at the moment.

761. Would you wish to? Would that be a good idea?

(*Dr England*) As it turns out the University is too far away, but if it was say in London, it would be very useful and an appropriate opportunity to do just that.

Chairman

762. I think we ought to ask you about the separation, as it is perceived, between basic research, which is something which everybody says the government ought to pay for because it is of such long term applicability if at all, and something nearer the market end, which most people say is a matter for industry to pay for. Once you have established that sort of division of responsibility it does mean that you have to take special measures to get the people at the two extremes together. I just wonder whether industry will come to the point before very long when they will say, "It's so important for us to bridge this gap that we have got to take part in the funding of basic science ourselves."

(*Dr Doyle*) I must say—and I think I would speak for some of the chemical industry—I think that is very remote. If anything, we have moved the other way to sharpen up the distinction of responsibility because the chemical industry has perhaps an over-preoccupied fear that the government is constantly trying to shift the burden of what it ought to invest in as a national asset towards industry. Industry is always on its guard for requests to fund capital projects in academia and other institutions and has really thought through quite carefully what it is appropriate to fund. If I dare use the Frascati term, it tends to actively support through putting in funding to what is described as "strategic and applied" for very good reasons, for wealth or other reasons, but it is really not down the track of supporting very long-term work which may be exploitable or may not be, even in the context of a mission-orientated culture. There may be a different view in some of the pharmaceutical industry but I find there is a strong industrial view that would adhere to that.

763. So we have an artificial gap which we have to invent special methods to bridge?

(*Dr Doyle*) I do not think it is an artificial gap because really the people you talk to in academia have a variety of projects and science under their wing which usually embraces both the basic and strategic. Hopefully they do not do too much applied although in the engineering faculties and the former polytechnics you tend to get a nearer to market approach and that is a natural type of research. I would have thought the spread in any academic department between basic and strategic is so considerable you get natural entrées to every department in the country.

(*Dr Giachardi*) It is no different from the spectrum you have in a company who are doing required research who are speaking the language of science to each other and those who are very much at the product and technical service end who are speaking the language of product performance to their customers. Those two languages are not mutually intelligible and you have to build bridges between them in the company so I do not think there is any great difference in that.

764. Can we try to look forward about a year or so and ask you what you would like to see OST say in its first Forward Look . What would you like them to say they had done in a year's time and were planning to do over the next year or two?

(*Dr Elves*) My Lord Chairman, in the first Forward Look there is obviously a limit to what can be expected but what we would expect, I think, to see is the embryo of the future starting to emerge; and that is a determination for some more focused and strategic and managed research to be undertaken in certain key areas. We have not got an unlimited financial resource for science and technology and, therefore, it is inevitable we have to make choices. I would like to see again the embryonic start to the developing of strategic, managed programme teams in areas of importance to the country, to its health, to its welfare and its wealth. How far along the line that could be taken within the first twelve months I would not like to say, but we ought to be seeing the start.

765. It sounds a bit like MINTEC, if you remember those days.

(*Dr Elves*) No, I don't.

(*Dr Giachardi*) If I look forward a year from now and longer-term, I think one of the things I would like to see people be able to say is that they have achieved what is in the White Paper and actually have

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implemented it because the White Paper is an excellent start, but there is still a very long way to go and we can see the structure that is proposed at the gross level, but we do not see what the substructure underneath it is and who would be involved. I would like to see that the mechanisms were in place and the people were in place.

Lord Dainton

766. Would you agree it is of crucial importance that the Director General is orchestrating these new research councils?

(*Dr Giarchardi*) I think it is absolutely important that the Director General of the Research Councils has the right amount of power to make sure that the things that risk falling in between the cracks between the research councils do not, and he has the right advisory body to make sure he understands what is going on, and that particularly means he must have some chemists advising him.

(*Dr Sim*) We have some doubts at the moment. The White Paper is not particularly clear. It makes statements regarding the function of the Director General, but the interpretation of these statements is still not clear to us. I think clarification as to exactly the role which the Director General has to play, and the power which he is going to exert in dealing with the Chairmen of the various Research Councils would be extremely important.

Chairman

767. Can we talk about that a little bit because it is the next important subject?

(*Dr Doyle*) I think it is one that we have picked up on where we have the highest degree of uncertainty about one of the most important aspects because, as written, it suggests a very powerful, if advisory, role and yet some of the messages, and they may be self-serving messages, suggest that it is not going to be as powerful as we think it ought to be. For reasons of manageability, we have divided up research councils to cover certain areas. It is clear from past history, which is often a useful guide, that bridging between the research councils is pretty ineffectual and yet if we are going to see the inter-disciplinary work and we are going to see important subjects that are identified as perhaps Foresight priorities properly supported, there has to be an overview about the efficacy of spending and one would naturally look to the DG of the Research Councils to offer trenchant, cogent and persuasive comments about how funding is deployed and where there seem to be gaps developing or where this position of resources is falling short of what seem to be the Foresight priorities. We think it is potentially an extremely important job indeed and yet, as we say, we have developed a concern even this early that it is going to be a toothless role. Perhaps our fears are unnecessary, but I think we would be watching that one very, very hard indeed.

768. Is your worry increased by the fact that each of the research councils is apparently now going to have a part-time industrial chairman who since he is going to be dealing with pretty distinguished and powerful people in their own right is going to have to be pretty powerful and distinguished himself or herself in each case, and the Director General is going to have to deal with these people? Does that seem to you a stable state of affairs?

(*Dr Doyle*) There is no reason why it should be unstable providing the remit of the DG is written very clearly and conveyed very clearly to the chairmen and vice chairmen of the research councils and I think the Chancellor and the Chief Scientific Adviser have to lay out specifically what the relationship is going to be.

769. Can you give us the headings of that relationship?

(*Dr Doyle*) No, not off the cuff. I think I would like to go away and reflect on that.

Lord Dean of Beswick

770. Are you saying that if that does not happen you could get different interpretations?

(*Dr Doyle*) Absolutely.

Earl of Selborne

771. It is clear, is it not, that when you redefine the roles of research councils what you do is you move the interface from one place to another?

(*Dr Doyle*) Absolutely.

772. And I suspect that our Committee will spend much of its report trying to determine what should happen at those interfaces, so the change we have got now is not just the structure of research councils, that their missions are changing, but also that there is a Director General whose job it is to see these gaps are plugged. Now, does that not, therefore, on the face of it seem to be an improvement?

(*Dr Doyle*) Yes, potentially.

773. I am not quite clear whether you expected the White Paper to set out precisely how the Director General sets about doing that job. Did I understand you to say that you would expect progress to be reported on in the Forward Look which will come in one year's time?

(*Dr Doyle*) I think someone has to be appointed and as his appointment is announced, one would expect to see the remit.

Lord Dainton

774. To a certain extent we are in a difficulty at the present time, are we not, because the precise remits of the research councils will be defined by the end of this month by Sir David Phillips and this will also relate to resources which does to my mind, and I wonder what your views are, it does mean that in the subject of, and I come back to, chemistry, because it is a good example, and there are other subjects, which purveys the whole of the research councils, that somehow that in its own right has to be kept healthy across the board as a subject and that must be one of the jobs which only the Director General of the Research Councils can really attend to. We must, therefore, to a certain extent, would you agree, wait until we see what the colour of Sir David Phillips's report is and weigh in, if that is your view, at that point if there appears to be a gap?

(*Dr England*) My Lord Chairman, if the Director General really is going to have the power to control

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the Research Councils, then as I felt on first reading the White Paper, this must be a line-management responsibility for the heads of the research councils. This seems to me almost the only way to guarantee real control and influence on the Research Councils, and an advisory role is just what it says, and I do not think it will lead to real liaison between the research councils, real control of what is going on. Now, I am not sure everybody agrees with this, but I have seen advisory roles end up being nothing other than someone talks to you, you say, "Yes, thank you very much", and then nothing happens. I believe that a line-management responsibility is almost essential for the Director-General.

Chairman

775. He has got to have executive powers to switch budgets around a bit and people around a bit.

(*Dr England*) Yes, indeed, but I know not everybody agrees with that.

Lord Dainton

776. He has to have the clout, particularly in view of the fact that the history of the research councils, I think you would agree, is a history of autonomy.

(*Dr England*) Yes, very much so.

(*Dr Elves*) I think, my Lord Chairman, there is considerable concern in our industry, and among the academics that we work with, about the new research council structure because in the pharmaceutical business—for instance, in the case of biotechnology—there was every opportunity for projects to fall down the crack between SERC and MRC, neither of whom were prepared to take responsibility for the project when they had a shortage of funds and where, for instance, it was a biotechnology problem that mentioned a human disease. There was then left a feeling of total frustration as to what would happen. That was quite beneficial, I think, in the long run for the collaborator, because we got fed up as well and we funded it rather than waiting for the research councils. We and our colleagues, I think, are looking to the Director General with a high degree of expectation that there will be somebody there who can resolve the boundary disputes, and in fact the boundaries become much less important than they are now because at the present time there are three-foot thick walls around them.

Chairman

777. You are saying that really you would like the system to operate as if it was a single research council?

(*Dr Elves*) Yes, that would be an ideal, but not attainable, I suspect.

Lord Dainton

778. Some of us have said that!

(*Dr Doyle*) I think the other thing, if I may, my Lord Chairman, in terms of what we would like to see a year or two on is that the Chief Scientific Adviser, if we are to get the best out of the public investment in science and technology, really does have to have an overview responsibility for the departmental spending that goes on science and technology on those activities that do not directly serve the Ministers and the departments. I know much of departmental spending is there to serve the Ministry, as such, but there is other spending, a sizeable proportion, which goes into the science and technology community. It seems to me if we are actually going to make the most effective use of the considerable funds there are before arguing for any more, there has to be a view not just over what the research councils spend, but over what these cognate Ministries also spend.

779. This highlights the delicacy of the relationship between the Director General of the Research Councils and the Chief Scientific Adviser whose remit goes over and beyond into the departments. Have you got any observations to give us on that relationship, how it should develop and whether it is satisfactory, as it is proposed?

(*Dr Doyle*) Yes, I am not clear how it is going to work in practice; that is the problem I think. I know what the theory says but I do not see the DG role as being an executive one, whatever we might want. It looks to me like a heavily advisory one and the real question in the end is, do the research councils cooperate in a way that enables him to give advice that is actually acted upon, because he is going to advise on it for a number of reasons, but he is not going to actually have the power to shift the funding it seems to me. That is going to be vested in the Chancellor in the end, I suspect.

Chairman

780. It probably has to be a question of whether the Chancellor will normally be expected to operate on the basis of the advice that he receives to such an extent that there is a delegation of power to all intents and purposes.

(*Dr Doyle*) Yes, and he has got advice from the DG. Equally he is going to have advice from his Council of Science and Technology.

Earl of Selborne

781. If I can pursue the point about the departments which we touched on, clearly it is within the Chief Scientific Adviser's responsibility to encourage departmental research programmes to be coordinated. I wonder whether we could hear further comment on how effective you think that is likely to be? What success, if any, do you think might be achieved with the Ministry of Defence which in the White Paper appears to be a little detached?

(*Dr Doyle*) Pass!

Chairman

782. That is the politest word used so far about that subject in the Committee.

(*Dr England*) If I may say, my Lord, probably one of the bigger disappointments of the White Paper was in terms of the Ministry of Defence. There is no doubt that with the decrease in spending on defence the one thing I think we would all very much like to see is not a decrease in total spending, but keeping the

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spend, and to transfer particularly the expertise from what are currently defence-related activities into the civil sector. I think it has been a constant problem in this country particularly for physicists and engineers where a lot of very good brains have gone into the defence industry. The defence industries basically are winding down, but there are no forward plans to transfer that expertise over into the civil base. I see this trend in my home town, which is next to Hatfield and British Aerospace, in a major way. Some very skilled people and a lot of high technology is just being allowed to run down with no plans for taking it forward. This was unfortunately one of the bigger disappointments of the White Paper for me.

783. I have just come back from Sweden where they have recently cut defence R&D expenditure by a very large amount and they then discussed in Cabinet what they were going to do with that money and they decided the taxpayer should have half of it and the other half should go to the research councils. Would that not be nice!

(*Dr England*) Yes.

(*Dr Sim*) An eminently sensible idea!

784. The White Paper, I suspect, will stand or fall in the future on the extent to which the OST is actually able to have an overview of the government's science and technology or the nation's science and technology, perhaps I should say, and be able to influence it. So what would you like to see developing in that sort of way? It is the Chief Scientific Adviser's responsibility in the first instance but also the Minister's.

(*Dr Doyle*) If you look at the words in the White Paper they do actually give both the Chief Scientific Adviser and incidentally the Director General, despite some of our reservations, very powerful charters. In fact, the DG's is actually spelt out at this stage rather more clearly, enabling the Chief Scientific Adviser to "concentrate upon his responsibilities for the lateral science and technology issues across all government departments." That is very interesting because it does not develop that and, of course, that immediately begs the question how he is to do it and what influence will he bring to bear and what is the possibility for change. There is, I think, the mechanism for exposing scientific programmes. I have seen that in operation but what I have not seen—and I do not know whether it is intended that it should be possible—is that he can actually bring about change in determining reduction here or there. I suspect he can only give heavy advice which may be then conveyed through the Chancellor. It seems to me Ministers value independence and I cannot see them being willingly subservient to advice even from the Office of Science and Technology. So I think it is quite difficult to see how things actually change unless he has a sort of dotted line responsibility or accountability for the programmes within departments, and I suspect that would be resisted strongly.

Chairman] There is a dotted line to the Prime Minister in all this.

Lord Dainton

785. Perhaps more importantly I think the Chief Scientific Adviser thinks he has the right of comment when bids are made to the Treasury and that is when the question of balance comes in. If that happened I should imagine you would be satisfied.

(*Dr Doyle*) Yes.

Chairman

786. But the Chancellor of the Duchy of Lancaster is chairing the Council of Science and Technology on behalf of the Prime Minister?

(*Dr Doyle*) Yes.

787. And that is a very important dotted line.

(*Dr Doyle*) It is indeed.

(*Dr England*) I think, my Lord Chairman, some of this needs to come down to more operational levels. I was quite pleased to find in the document from the National Health Service Department of Research and Development Professor Michael Peckham's department, not only do they have a concordat with the Medical Research Council, but details of how they are actually going to operate in terms of inputs and outputs from industry and other people outside the NHS. I think to some extent this may be a blueprint other departments ought to be looking at. Until we see it fully in operation, of course, it may not work, but I do believe it is necessary to go down one or two levels in terms of where decisions are made. Broad areas of funding can be decided at senior levels, but when we are talking about decisions on large numbers of relatively small sums, this is the sort of operational level where I think OST will need to be involved. It is nice to have a general policy but I do believe it is important to get it into operation.

788. Where do the activities of the government research establishments fit into all of this, do you think? Some of them are very department—orientated and possibly one does not have to ask the question of them too much, but most of the larger ones at any rate do a lot of work that is not tightly tied to departmental needs.

(*Dr Giachardi*) I think, my Lord Chairman, it depends which particular establishments you look at but if you look, for example, at some of the ones connected with the DTI like the National Physical Laboratory and the Laboratory of the Government Chemist the problem in answering your question there is you have a whole spectrum of activities. The NPL has a variety of work from testing composite materials all the way through to maintaining primary standards and what is difficult at the moment is the way that these institutions are being put on agency status when it really is quite hard to put a value on the maintenance of the primary kilogramme. We all know we need one but it is quite difficult to put a value on it.

(*Dr Giachardi*) I think we have got to look at it on a case by case basis. I think what it does bring to the fore is one role the OST could have, as well as looking laterally across all the departments and government establishments, to try and inject into those establishments best management practice that you can see from the industrial sector. There is considerable scope I believe for transferring best

[Chairman *contd.*]

practice in management into those institutions. I would hope the OST can help in that area.

789. Yes, although it is not primarily geared towards management, is it?

(*Dr Giachardi*) But it could be part of its remit to improve the management of science and technology.

790. That is a very useful suggestion. You express some unease about the new Biotechnology and Biological Sciences Research Council. Would you like to elaborate a little bit on why you are uneasy about that?

(*Dr Elves*) One of the reasons for the unease is that it is apparently taking biotechnology and placing it all under one heading, whereas in fact biotechnology, as it is a fairly generic activity, cuts right across a number of the other councils too. It certainly cuts across the Medical Research Council in a very important way for us. It cuts across chemistry in the application of fermentation technology which, after all, is still biotechnology, albeit rather low-tech: there is the question of the use of biotransinformation. It also cuts across agro-chemicals, the agricultural field, and into the environment as well. I think the concern is largely conditioned by previous experience of the way research councils operate, which I have already alluded to, that if they continue to operate in that sort of closed-shop way, then I think the academic and science community generally feel very concerned that a very important area of technology is going to be tightly buttoned up. If, on the other hand, the boundaries are vague and the other research councils can engage themselves in areas of biotechnology most appropriate to their activities, then I think the fears will disappear.

(*Dr Doyle*) One of the things that looks curious at the moment is that with the division, biochemical engineering, which is of course absolutely critical to the practical application of biotechnology, seems to be resident still with engineering.

791. And control engineering.

(*Dr Doyle*) Absolutely, and we have, therefore, a very unnatural separation. I think the pass is sold in the sense that molecular recognition and bi-organic chemistry will go to the B&B Research Council and I think one has to go the whole hog and somehow move responsibility. I think both biochemical engineering and the related bits of control enineering really have to be considered there as well, otherwise we will, in what is an important, inter-disciplinary area, have a very unnatural divide. We have to create the interface somewhere, but that looks a particularly curious one.

Earl of Selborne

792. You can argue this every way, can you not, because had the divide of biotechnology been to push it into the research council for the physical sciences, then it might have looked rather odd to have biological sciences in one research council and biotechnology in another. Would you agree, therefore, that this seems to be an area where the Director General should be requiring an input for biotechnology from at least two, probably three, of the research councils?

(*Dr Doyle*) Yes, but I think before that we need to make strong representations to the boundary study by Sir David Phillips, to see whether you actually solve the problem. Certainly there have been so many representations to Tom Blundell that I think he is fed up with being beaten on the head by chemists. He professes to be sensitive to the problem, but what we are interested in is whether he then acts on the problem.

Lord Dainton

793. Would you not agree the problem really has two aspects, as I think Earl Selborne was indicating, namely that you brigade a lot of activities together from the point of view of the health of the underlying science of which they form a part and you then brigade them together in what is probably a different way according to their applicability and somebody has got to keep an eye on this at both ends and would that be the Director General? You were saying, for example, it seems to be quite reasonable that the large elements of bio-engineering properly belong in engineering from the discipline point of view, process engineering, for example, but, on the other hand, there is an aspect of bio-engineering which relates to the actual chemical process that is going on which relates it to another part of science and in a sense you cannot get the full output from the first unless the other is right, so that somebody who is transcendentally above the research council has to watch all this all the time.

(*Dr Doyle*) I think we have the best of both worlds because what we are actually talking about is the funding mechanisms here and you have to remember that if we talk of biochemical engineering as one specific area of concern, it does not want to be isolated when it comes to the funding for the other aspects of biotechnology, but inevitably when you actually look at its location in an academic sense it has got contiguity with its engineering disciplines, so it will not be cut off in a disciplinary sense and it will have the best of both worlds.

Lord Dainton] It could have the best or it could have the worst. It all depends, does it not, on the extent to which the Engineering and Business Research Council understands the first point you have made and if it does not it will fail and, therefore, it must be somebody's business to see it does not fail.

Chairman

794. May I just use the last couple of minutes to ask you how you regard the present state of the science base in this country? Do you regard it as holding its head up to the rest of the world within limited resources, but then everybody's resources are limited nowadays? How do you view it? Do you feel you have to go abroad for most of the basic research that you do or can you find it at home?

(*Dr Elves*) The answer to that question is we can find much of what we want at home, but what we encounter, when we meet up with our academic colleagues, is good scientists and technologists who are working under very adverse conditions. I have recently gone around the chemistry laboratories at the University of Cambridge and quite frankly

[Chairman *contd.*]

Cavendish would have felt at home, I think! On the other hand, there are other universities where the facilities are excellent; I have also visited Sunderland, for instance, who were fortunate to get a large block grant before the system changed, and their chemistry resource is superb. But, by and large, I think we have seen over the last five or ten years a very severe erosion of the infrastructure under which our academic colleagues are having to work. I think a lot of them are coming to the point where they cannot sustain good science.

(*Dr Doyle*) I think they hold their heads up remarkably well considering the state of underfunding which they suffer and that is true, I think, from an infrastructure point of view. I think it is also true from a research grant support point of view and I think it is true from a salary point of view.

(*Dr Sim*) I think our worry about it would be that a lot of the good science on which our success is based it that which was started ten or 15 years ago. Our worry is not now, where we are still profiting from this, but ten years ahead.

795. Do you have evidence to cause you to be worried?

(*Dr Sim*) I think very often this is the impression one gains because we do a lot of visiting and working with academic people. We do see the kind of things that Dr Elves was talking about in terms of the conditions under which academics are working. I think our worry is that the situation will get worse in some years' time.

Lord Dainton

796. Do I take it from these remarks that you would endorse very strongly the wish that the Chancellor of the Duchy of Lancaster expressed in the White Paper to have an input in the Department for Education insofar as the dual support system and support of research students is concerned?

(*Dr Sim*) Yes.

Chairman] Well, thank you all very much.

WRITTEN EVIDENCE

Memorandum from AEA Technology

Q1. *What is public expenditure on the Science Base for?*

There are two components: expenditure for science itself, and expenditure for the use of science. The former is emphasised in the university science base, who identify two components:

- Science for itself: that self-regulating enterprise which preserves and develops the body of Science. In the past the major part of the Research Councils' and Universities' activities were in this class.
- Cultural: the education of informed people who can operate effectively in the modern context. This role is a general cultural and societal one, the so-called "social overhead" which aids the quality of life.

Expenditure for the use of science has likewise two strands related to the profitable exploitation of innovation and know-how:

- Economic: a means to ensure economic development and competitiveness. This is the so-called "technical overhead" yielding capabilities to achieve societal goals. It provides a link to industry as employer as well as supplier.
- Political: a means to ensure national power or prestige, or to aid informed discussion of policy options.

These two strands which lead to wealth creation are the justification for substantial investment in Science and Technology.

Q2. *What are the objectives and priorities of the various funding agencies within Government?—Research Councils, HEFCs, other departments. Are they related? Is an overview required, and do the existing structures (ABRC, ACOST, OST) provide it?*

There are three reasons for seeking an overview. One is to bring into the open the question of whether (or to what extent) UK science policy should be for SCIENCE or for the USE of Science. At present, the Research Councils, and the various science-sponsoring Government Departments, all have their own views as seen in recent discussions on the Science and Technology White Paper. Because of the fragmented organisation of UK science (and especially the divide between academia and industry forced by that organisational structure) and the substantial spend of public funds a greater degree of coherence is essential.

At the moment Research Councils and most Universities are trying to do too many different things—teaching, fundamental research, applied research, commercial work, technology transfer—which demand different skills.

A second reason for an overview is that so much of our science and engineering base is in the process of reorganising. There is a big decline in research in some of the science-based and engineering-based industries, like the formerly nationalised energy industries, and the AEA, and there has been restructuring of the HEIs as more universities are created. There is a real danger that some key resources will be lost or duplicated.

A third reason for an overview is that nowadays at least an EC and preferably a world perspective is needed, and this should be done systematically in advance of the next EC initiatives.

Do ABRC, ACOST, OST provide this overview? It is not clear that either ACOST or the ABRC supplied an overview. ACOST did go some way, but lacked representation from the Independent Research Organisations and from non-Research Council national laboratories. The ABRC only concerned itself with those organisations which can receive its funding. Their role will soon be changed as laid out in the White Paper on Science and Technology and responsibility for the overview will centre on OST. The new framework is welcome but of course it will only add value if implemented in a sensible way.

Q3. *What are the relationships connecting Government funding of the Science Base, funding by industry and charities, and overseas funding (particularly from the EEC)? Various people are "paying the piper": are they calling different or incompatible tunes, and if so is this a bad thing?*

Generally, it is healthy that there are different sources of funding with different perspectives. This is especially true when new areas emerge which are interdisciplinary (meaning here lying between two currently standard areas) or when the stage of development (pre-competitive, pre-launch, etc) does not fit the standard rules for one of the sources.

Probably the two main needs which are hard to ensure are first that there is acceptably little duplication (eg two expensive facilities funded separately where one would have sufficed), and secondly that the RIGHT body leads in priorities (eg the HEFCs are mainly poorly placed to judge industry needs, and industry inclines to the short term). Whilst technology transfer is not part of the evidence sought, it is clear that the best funding systems will help such transfer by encouraging the right research-development-business partnership early on. Moreover, such partnerships could be helped by the right sort of training in universities (ranging from the writing of proposals to quality assurance and basics of project management).

Q4. *What information and advice is needed by those who are setting priorities? How do they know what is going on in current low-priority fields? How do they track developments overseas?*

Here there is a responsibility to seek information from as wide a range of science and engineering sources as is possible, ie not just university staff, or manufacturing industry, but including the independent Research Organisations and national laboratories. Good co-ordinating officers can be very effective, but the range of their contacts is critical. A more effective use of existing information is a priority area and technology based consultancies could play a key role here.

In AEA's experience tracking EC proposals and programmes is particularly difficult.

Q5. *How do charities and companies which fund research set and implement priorities? How is it done overseas? Are there lessons here for the Government?*

Within AEA Technology, priorities are set through a combination of inputs, both top-down and bottom-up, plus the very important component of continuous review:

— the overall level of investment in research is set centrally, based on a view as to what funding is available;

— there are proposals (initially mini-proposals) from the scientific and engineering staff, who know well the key criteria (including commercial ones); these are assessed by their management in conjunction with the Research Managers and those responsible for developing commercial and business initiatives;

— those projects approved are given regular appraisal, both formal and informal, both scientific and commercial, throughout their term. This is designed both to guide the project (or to end it or enhance it where appropriate) and also to make sure that any value the project could have for other projects is recognised and exploited.

Are there lessons for the Government from methods used overseas?

There are some useful ideas, though not all are universally applicable. Thus the EC approach (greatly improved on what it was once) uses a wide range of referees, not just from one country. This practice could usefully be adopted more widely in the UK. The US NSF holds workshops in what are perceived growth areas, often with representatives of the current related area (eg the Panel on Atomic Scale Microscopy considered both electron microscopy and scanning probe microscopies). The NSF Panels (like those of the US Department of Energy) attempt to involve all science and engineering sectors, which is good. The NSF will accept proposals from industry and even from UK industry—though few—whereas the UK Research Councils will not accept proposals for research grants which give funding to UK industry. The proposals in the Science and Technology White Paper for a "fully open market for R&D" and a Technology Foresight programme could, if suitably implemented, go a long way towards helping here.

Note to Witnesses in Industry, Charities and Government Departments

What does AEA put into the science base? This can be (a) cash, (b) staff, especially through our direct university participation, not to mention the number of university staff we have trained over the years, (c) resources access, especially to large or novel equipment, (d) collaborations in initiatives like LINK, EC programmes and the associated training within a business environment.

AEA is supportive of the idea of "Faraday Centres" as a bridge between the different values and goals of industry and academia. Because of our size, reputation, breadth of activity and numerous contacts we believe we could play a leading part in developing and implementing the idea. However, we would prefer a model closer to Germany's Fraunhofer Institutes than the UK's Postgraduate Training Partnerships.

What does AEA get out of it and whether it meets expectations? This can be (a) potential employees, (b) access to other facilities, (c) research tasks, (d) overview of developments in areas we don't do ourselves. The real limitation is that it is too necessary to regard other parties as competitors for funds, rather than collaborators. This isn't a particular AEA problem; indeed we suffer less than most. But the shortage of funds, and the way the funds are divided into rigid categories, both inhibit the flexible interactions which can make research and development collaborations effective and efficient. A good career structure in the universities would help to improve their research efficiency. A flexible career structure—moves to and fro between industry and academia—would be even better.

2 *July* 1993

Memorandum from the Agricultural and Food Research Council

1. What is public expenditure on the Science Base for?

Public funding of basic and strategic science and technology aims to advance knowledge and to train scientists and engineers at postgraduate level. Transfer of technology and people from the Science Base encourages innovation in industry, contributes to wealth creation and improves the quality of life. For example, the beneficiaries of AFRC research include food, farming and other biologically-based industries, policy makers in Government, consumers and the general public.

2. What are the objectives and priorities of the various funding agencies within Government?—Research Councils, HEFCS, other departments. Are they related? Is an overview required and do existing structures (ABRC, ACOST and OST) provide it?

The objectives of the various S&T funding agencies within Government are distinct but related. Research councils support basic and strategic research and postgraduate training within defined missions. The HE funding councils support research and teaching. Departments on the other hand support R&D in pursuit of policy objectives such as public safety, regulation and procurement.

An overview of the totality of Government R&D spending is most certainly needed. This is the responsibility of the Chief Scientific Adviser. The new arrangements within OPSS provide an opportunity for strengthening the Chief Scientific Adviser's co-ordinating role.

There should be a national science council, chaired by a distinguished industrial or academic scientist, to advise Government on broad policies within the total envelope of public funded S&T (£5bn a year). Membership should be broader than that of ACOST and might include scientists, engineers, economists and policy makers and the heads of research councils and the HE funding councils.

Priorities within the £1bn Science Budget need advice from research scientists and engineers.

There is a continuing need for detailed analysis of particular S&T issues and of policy options to inform both the national science council and the Science Budget advisory body. These studies should be undertaken by the Chief Scientific Adviser as part of the normal work of OST.

3. What are the relationships connecting Government funding of the Science Base, funding by industry and charities and overseas funding (particularly from the EC)? Various people are "paying the piper": are they calling different or incompatible tunes, and if so is this a bad thing?

Each funding source has its own objectives and priorities. A plural funding base is, on balance, a good thing. Research bodies have to be flexible and resilient to exploit the diversity of funding opportunities. AFRC has increased its annual income from external sources such as industry, charities and the EC from £10m in 1986–87 to £24m currently.

Historically MAFF has been the AFRC's largest single source of funds outside the Science Budget (currently £35m). A special customer—supplier relationship has operated over the years, with the Ministry being represented on the AFRC Council and on key scientific planning committees. Recent changes in R&D commissioning procedures within the Ministry and the objective of broadening its contractor base are causing managerial problems for AFRC.

On industrial collaboration, LINK and AFRC's own collaboration with industry scheme (CWIS) effectively provide a framework to ensure "harmony" between the tunes played by public and private R&D funders. AFRC is a relatively strong player in LINK, sponsoring 10 of the current programmes in partnership with DTI, MAFF and SO.

At a tactical level EC funding is broadly compatible with UK R&D priorities because part funding by the EC has to map onto existing projects. At a strategic level, there is potential for divergence as the UK is only one of 12 voices determining the scale and shape of programmes. The EuroPES system, which seeks to view domestic and EC funding of R&D as two parts of a single cake, could lead to the frustration or distortion of national UK priorities. Subsidiarity should continue to be an important guiding principle.

4. What information and advice is needed by those who are setting priorities? How do they know what is going on in current low-priority fields? How do they track developments overseas?

For a mission-oriented research organisation like AFRC, R&D priorities reflect the twin forces of scientific opportunity and technology or market pull. Priorities must be set, therefore, on the basis of information and advice from scientists and from representatives of industry, Governmental departments and of other beneficiaries of the R&D. These requirements are reflected in the composition of AFRC's science planning structures and in the programme of work which involves visits to research laboratories, scientific opportunities meetings and contributions from overseas scientists to research planning and assessment.

How do charities and companies which fund research set and implement priorities? How is it done overseas? Are there lessons here for the Government?

In industry AFRC discerns a move away from corporate research laboratories, remote from the production processes, which determine their own R&D priorities. The trend seems to be towards R&D projects being conceived, agreed and managed as part of the main business. Appraisal of potential projects thus involves scientific feasibility and business opportunity.

6. **What are the objectives and priorities of the HEFCs in funding university research through block grants, and who is setting them and on what basis?**

Broadly speaking, the HE funding councils look to universities to determine their own research policies and priorities within the total R and T funds provided.

AFRC welcomes strategic discussions with Vice Chancellors about their research policies and the role that AFRC might play, within a framework of peer review, in funding new initiatives.

7. **How is each university's block grant distributed between departments, and on what basis?**

There should be broad consistency between research council funding of research and a university's own investment from its HE funding council block grant. The aim should be an optimal infrastructure of buildings, staff and other basic facilities to exploit fully research council selective support.

Greater transparency in the distribution of the block grant would improve accountability and help to achieve comparable research costing procedures between universities and other bodies.

8. **What are the impacts on priority setting of—**

   (a) **abolition of the binary divide**

   (b) **the regionalisation of funding**

   (c) **the dual support transfer of £150m**

   (d) **formula funding, research assessment and R–T–X?**

On (a), AFRC has always considered polytechnic research grant applications in the same way as those from universities. The small number of awards reflected the modest number of applications. Pump priming funds from HE funding councils to the former polys should enhance their research capabilities. But it will be important to discourage mission drift, a point made frequently by Professor Graeme Davies.

As for (b), Scottish and Welsh HE funding councils are beginning to encourage distinctive research priorities and portfolios in these countries. This could be accelerated by the interesting possibility of extra funding from Scottish and Welsh Offices and/or the national development agencies. This could lead to a changed profile of research grant applications to the UK research councils.

The dual support transfer (DST) of £150m has helped moves towards fuller and more explicit costing of university research. It has not influenced the priority setting of AFRC in the sense that research grant applications continue to be approved by peer review.

Finally, on (d), formula funding and the research assessment exercises are putting pressures on universities to develop research strategies and to back these priorities when allocating funds for research. Selectivity may well lead to university departments with stronger or weaker commitments to research and to postgraduate training.

9. **The Research Councils have explicit missions. How are these translated into priorities, by whom and on what basis?**

AFRC research priorities are determined by the interaction of scientific opportunity and technology or market pull. Existing programmes and new proposals are reviewed in an annual planning cycle. The main elements in the cycle are:

   (i) **Scientific opportunities** These are fed into the planning process from a special annual meeting of scientists, *ad hoc* scientific discussions within the research community, institute directors' initiatives, research grants boards, the AFRC Think Tank and, occasionally, top down from ABRC.

   (i) **Customers and beneficiaries** contribute through the Priorities Board, the plans of Government departments, direct interaction with, for example, agricultural producers' groups, representatives on institute governing bodies, AFRC research committees and Council itself.

   (iii) **Research committees** review progress of current research and appraise new programme proposals against criteria of scientific opportunity, quality, timeliness, exploitability and applicability to wealth creation and/or the quality of life.

(iv) The **AFRC Strategy Board** and **Council** itself reconcile plans from four research committees with AFRC's overall policy objectives and available resources. New priorities are introduced by displacing lower priority work (about 10 per cent annual turnover) and by seeking additional funds from OST *via* the ABRC and from other sources.

(v) These plans are described annually in the **AFRC Corporate Plan** and the **Forward Look** submitted to ABRC.

10. **How are the competing priorities of the different Research Councils (and the Royal Society and the Royal Academy of Engineering) reconciled within the limits of the Science Budget?**

ABRC rigorously appraises the plans of each funded body, both baseline programmes and new proposals, as set out in annual Corporate Plans and Forward Looks. The main appraisal criteria are scientific opportunity, quality, exploitability and applicability. Value for money is a key consideration for major capital projects. By these processes the Board recommends the allocation of the Science Budget. In recent years AFRC has received additional funding for institute restructuring projects as well as for new co-ordinated programmes in plant molecular biology, stem cell biology and other areas of high scientific interest and opportunity.

11. **Are the priorities of the Research Councils skewed by the boundaries between Councils' remits, by the existence of Research Council institutes, by international obligations to support big science, or by anything else?**

Many current scientific advances are interdisciplinary and are in the boundaries between Councils' remits. Planning processes now recognise this and several recent programmes involve joint planning and execution. Examples include the Joint Agriculture and Environment Programme (JAEP) involving AFRC, ESRC and NERC; Clean technology (AFRC and SERC); Pollutant transport (AFRC and NERC) and the joint AFRC/MRC Neuropathogenesis Unit.

As for research institutes, AFRC has worked hard over the past decade to achieve a better balance between institute and university research. Ten years ago the institute sector was dominant and this inevitably limited flexibility to support new scientific areas and influenced priorities and resource allocation. The following figures illustrate the shift of resources towards the universities which has created a more flexible and responsive "mixed economy" of delivery mechanisms.

AFRC Science Budget funding by sector

	1983-84	*1993-94 (planned)*
Universities	8	36
Institutes	62	52

(£M at 1993-94 prices, using GDP deflators)

International obligations to big science are a potential distortion. It is unclear whether Government would agree to reduce commitments or to pull out of CERN simply on scientific advice from ABRC. Wider political considerations might be brought to bear.

EC R&D funding is another potential distorting factor. If subsidiarity is not respected and if attribution were increasingly applied to the Science Budget, the net effect would be a transfer of resource and decision making from UK structures to the Commission.

12. **How is the money transferred from the UFC to the research councils being spent?**

All the transferred funds are being used to meet increased direct and indirect costs of research grants in line with the formulae derived from a joint ABRC/CVCP study of research costs. To illustrate the point, AFRC is receiving a cash increase of just over 50 per cent for research grants as a result of the transfer. Applicants are seeking an average 53 per cent more than previously (£95K up to £145K) and average awards have increased by 54 per cent (£80K up to £123K). No part of the extra cash has been used to increase the number of grants awarded. Some fine tuning may be needed in the light of experience and of the recent study by university finance officers.

The transfer was intended to channel the necessary support funds to successful research groups. AFRC would be disappointed if universities were re-allocating HE funding council R funds to the disadvantage of successful departments, highly rated in the research assessment exercise, to prop up weaker research groups.

20 *May* 1993

Memorandum by the Ministry of Agriculture, Fisheries and Food

1. This note, by the Ministry of Agriculture, Fisheries and Food, is provided in response to the Select Committee's call for evidence which was issued earlier this year. The Sub-Committee invited submissions on a range of specific questions. In accordance with the terms of the invitation, the Ministry has not attempted to answer every question, but has concentrated on those which relate directly to its particular responsibilities

in its role as a provider of funds to the Science Base. For the sake of coherence and brevity the issues are dealt with thematically rather than under question headings.

2. The White Paper "Realising our potential—A Strategy for Science, Engineering and Technology" sets out the Government's view of its broad scientific objectives and priorities, and arrangements for coordination and provision of an overview. Within this general framework, the Ministry of Agriculture, Fisheries and Food commissions a substantial and diverse range of research, much of it from the Science Base as defined for the purposes of the Select Committee's enquiry. The following table sets out the amounts spent by MAFF on research commissioned with the Science Base in 1992-93 and the proportion of total MAFF R&D funding which these represent. It also shows the amount of funding by MAFF of postgraduate studentships in the same period.

	£ million	*per cent*
Research commissioned with:		
(a) Research Councils	39.7	30
(b) Universities	6.4	4.8
by value and as a percentage of MAFF total R&D		
Postgraduate training	1.2	—

3. The Ministry is thus a significant source of public expenditure in the Science Base, especially with the Agricultural and Food Research Council (AFRC). In 1991–92, for example, of the AFRC's total income of £155.1 million, £34.5 million (some 22 per cent) was earned in carrying out research commissioned by MAFF. Similarly, to a more modest extent, the Natural Environment Research Council derives a proportion of its funding (about 2.5 per cent in 1991–92) from MAFF commissioned R&D. As far as this proportion, at least, of the Science Base's income is concerned, the question as to what the public expenditure is for must therefore be answered in terms of Departmental policies. By the same token, the prioritisation of that part of the Science Base's work which is commissioned by MAFF reflects the priorities established within and between these policies.

4. All the research funded by the Ministry, including that undertaken by the Science Base, is obtained for the purpose of supporting or implementing Departmental policies, or providing scientific foresight and options for future policy development. Reflecting the Ministry's aims it therefore embraces public protection, protection and, where appropriate, enhancement of the environment (eg Environmentally Sensitive Areas), prevention of flooding and coastal erosion, improving animal welfare, and improving the economic performance of the agriculture, fishing and food industries. Hence, the Ministry's funding spans a broad range of strategic and specific applied research, rather than basic science. The decisive factors in the Ministry's choice of contractor are the quality of science, the level and appropriateness of available expertise, the facilities and value for money generally. Reflecting the Government's commitment to market testing and the cost effective use of resources, an increasing proportion of research is being placed by competitive tendering.

5. It follows that, from the Ministry's perspective, the distinction between the Science Base as defined for the Sub-Committee's enquiry and other R&D suppliers is somewhat artificial. In any event, it is clear that "Science Base" is not wholly synonymous with "basic science". Nevertheless, it is recognised that all funding bodies necessarily have their own perspective. The Research Councils are both recipients of funding and funding bodies themselves. MAFF does not attempt or expect to determine the whole range of the Science Base's activities, even within the agriculture, food and fisheries sectors. The Ministry welcomes the plurality of funding within the sectors of concern to it, and the freedom which each funding body rightly enjoys to establish its own priorities. It follows, though, that a measure of coordination and cooperation is important.

6. The Priorities Board for Research and Development in Agriculture and Food helps to ensure this. The Board advises the Agriculture Ministers and the Chairman of the Agricultural and Food Research Council on priorities for research and development and on the allocation of budgets between broad sectors. The membership of the Board and its sectoral groups brings together representatives of industry, government and the Science Base, and provides a valued forum for consideration of the alignment of publicly funded research and industry's current and future R&D programmes. Implementation of the Board's recommendations is considered collaboratively by the sponsoring bodies in government and the Science Base to help ensure that their research effort is compatible and directed towards mutually beneficial ends while avoiding gaps or duplication.

7. It is reasonable to assume, therefore, that prioritisation within the Science Base is influenced to some extent by Departmental requirements for applied research, and by coordination of the kind described as well as through bilateral contact. While MAFF does not have the financial responsibility for supporting the Science Base *per se*, as a customer for R&D it has an obvious interest in the maintenance of a skills base and facilities which are attuned to its needs. Within each Council, the existence of institutes may certainly influence the priorities for research, reflecting the availability of particular skills and, perhaps also, a particular outlook or ethos. This is therefore a factor which purchasing Departments such as MAFF need to take into account in their commissioning decisions even in the context of policy of competition in an open market. For their

part, the institutes themselves need to be alive to the evolving requirements of Departmental customers, and to remain sufficiently adaptable to be able to meet these needs.

8. The White Paper has announced the Government's intention of redrawing the Research Council's boundaries, to create new Research Councils on 1 April 1994. The Ministry of Agriculture, Fisheries and Food is concerned primarily with the Agricultural and Food Research Council and its successor, the Biotechnology and Biological Sciences Research Council, but also has an interest in others, particularly the Natural Environment Research Council and the Medical Research Council. It remains to be seen how the boundaries between the Councils' remits will affect the priorities. In the past, the cross-sectoral nature of food research, covering areas as diverse as food psychology, nutrition, toxicology, chemistry, physics and food process engineering, may have been a disadvantage as far as coverage by the Research Councils was concerned. The existing structure has similarly not been ideally suited to addressing the interface between agriculture and environmental concerns. Demarcations in areas of overlap, for example between the new BBSRC and the NERC and MRC, will always be matters of fine judgement. The key will be good cooperation and coordination between the Councils. The role of the new Director-General for Research Councils will therefore be crucial.

9. As far as overseas funding for the UK Science Base is concerned, the Ministry's influence is limited and indirect. In collaboration with the Office of Science and Technology, MAFF seeks to ensure that European Community research funding is compatible with UK priorities. The UK Science Base has had considerable success in winning Community-funded contracts, but the Ministry has no locus in deciding which institutes compete for contracts and, in common with the other Member States, very little influence over the Commission's funding decisions.

Letter from the Association for the Study of Animal Behaviour

I am writing on behalf of the Association for the Study of Animal Behaviour (ASAB) in response to your request for evidence for Sub-Committee 1. ASAB is the Learned Society for the Study of Animal Behaviour in the United Kingdom and other European countries. It owns and publishes the premier journal in the field, "Animal Behaviour" (Institutional subscriptions in 1992: 1,282). ASAB has a membership of approximately 1,500 drawn principally from eight European countries including the UK. There are also close links with a sister society (The Animal Behaviour Society) in North America.

Rather than answer your questions point by point, I would like to highlight two issues of particular concern to ASAB.

1. *The Dual Support Transfer*

Much research in the field of animal behaviour, in common with a number of other areas of biology such as taxonomy, is of relatively low cost and has traditionally been funded under the Dual Support system. Now that the funding of research in universities through the Dual Support system is negligible, it is difficult to carry out even a modest research programme without a grant from the Research Councils. Thus the Dual Support transfer has led to substantial erosion of research in fields such as animal behaviour. ASAB has responded to this situation by setting aside some of its journal income in order to provide research funds for the scientific community of its membership. Each year, the Association awards small grants, travel grants and workshop grants up to a total in the region of £80,000. Although this modest contribution provides some help, we feel that the primary support for university research should come from the government.

2. *Reorganisation of Research Councils*

At the moment, research in the field of animal behaviour is funded by four of the research councils. MRC provides grants in the field of behavioural neuroscience, NERC in behavioural ecology, AFRC in behaviour and welfare, and SERC in evolutionary studies of behaviour, learning, motivation, and non-medical behavioural neurobiology. In the past, the Research Councils have been generally effective in dealing with grant applications in the field of animal behaviour that lie on the boundaries and our members do not feel they have suffered as a result of this spread across four Councils.

However, a possible area of concern for the future arises from the fact that SERC is the principle provider of funds for many aspects of behavioural research (the current figure is approximately £9.5 million per annum). The reorganisation of SERC and the creation of the mission oriented BBSRC may lead to relatively small, "low priority" fields dropping out of the corporate objectives of the Council even though, as with animal behaviour, the UK has world pre-eminence in the field. We hope that in planning the funding pattern of the BBSRC attention is paid to smaller areas of biology and that funding is not directed exclusively into the currently fashionable and apparently most applicable fields.

I hope these comments are of some help to Sub-Committee I. I would be happy to elaborate on them and provide documentation if requested.

John R. Krebs, President

16 *June* 1993

Memorandum from the Association of Independent Research and Technology Organisations (AIRTO)

This evidence is submitted in answer to Question 3 only.

The relationship between industrial and public funding of the science base has become confused. Pressure to reduce public expenditure and the mistaken belief that universities which have large contract research income are therefore doing the most relevant science have led to the position where the universities are forced to reduce their efforts for teaching (their primary task) and pure research (their secondary task) in favour of contract work (very much a tertiary task).

A more balanced position for the long term would have universities publicly funded to do first rate research in areas of interest to industry, industry acting as a patron, not customer, to contribute some cash but, more importantly, guidance as to industrial relevance in exchange for oversight of the work and development being carried out within industry.

A crucial element of this is to reverse the present position in which universities are encouraged to exploit their intellectual property rights to one in which they are encouraged to seek exploitation of their ideas.

Memorandum from the Association of Medical Research Charities

SUMMARY

1. The Association of Medical Research Charities represents 73 member and affiliated charities. Their contribution to United Kingdom medical research has grown steadily in the past 10 years and in 1992–93 amounted to almost £270 million. A criterion for membership of and affiliation to the association is that charities must use peer review in the allocation of grants and awards for research.

2. The public's desire to support research to increase knowledge of an area of medicine in order to improve diagnosis, prevention and treatment of disease is reflected in the broadly based and generous support given to medical research charities.

3. Medical research charities exist with the primary purpose of improving health through supporting research: an aim which is in the public good and is purely philanthropic. Such support is substantially different from commercially commissioned or funded research.

4. It should not be forgotten that individuals who are funded by charities to do research also undertake teaching and other responsibilities within HEIs and clinical duties within the NHS.

5. The UK pharmaceutical industry is one of the strongest sectors in the economy: it too benefits greatly from the broad scientific base for medical research which has developed under the present funding mechanisms.

6. Charities are now the principal source of funding for research into many disease areas; they fund both applied research and research into areas of basic biomedical science valuable to all medicine.

7. Whilst the public, through the charitable sector, can and does play a major role in the support of basic and clinical medical research, it cannot and will not accept the further burden of funding the infrastructure which underpins research and which it believes should be supported from Treasury sources.

8. In the view of the Association, the government takes for granted that the funds available from charities will continue to support the science base in universities. Many UK medical research charities, including the Wellcome Trust, are free to support medical research anywhere in the world.

9. The Association's principal concern is the fragmented way in which decisions regarding the medical science base are made and which create the environment in which charities must operate.

10. The Association would like to see the establishment of a standing committee which would bring together those sectors with an interest in UK medical research.

11. Advances of practical importance in the biomedical sciences have their roots in basic research. The history of the biomedical sciences shows that many of those lines of basic research which have ultimately led to major progress have not been recognised as such in advance.

12. A plurality of sources of funding (including the MRC and the individual charities, industry and government departments) is beneficial to the science community and has produced an outstandingly strong environment for medical research in the UK.

13. The Association believes that the government, through the funding councils, should continue to provide financial support to universities to underpin peer reviewed research funded by charities.

A. ASSOCIATION OF MEDICAL RESEARCH CHARITIES

The Association of Medical Research Charities represents 73 member and affiliated charities. Their contribution to United Kingdom medical research has grown steadily in the past 10 years and in 1992–93 amounted to almost £270 million (see Table).

A criterion for membership of and affiliation to the Association is that charities must use peer review in the allocation of grants and awards for research.

SPECIFIC QUESTIONS SET BY SUB-COMMITTEE I

1. *What is public expenditure on the science base for?*

1.1 The Association is aware that the focus of the Committee's interest is government funding for the science base. However, it is its view that it should be acknowledged that "public" expenditure on the UK science base does not come only from government sources. The public's desire to support research to increase knowledge of an area of medicine in order to improve diagnosis, prevention and treatment of disease is reflected in the broadly based and generous support given to medical research charities: the public has few other ways in which it is able to influence directly the support of medical research in areas where it is perceived that government funding is insufficient.

2. *What are the objectives and priorities of the various funding agencies within government?*

2.1 The Association has welcomed government acknowledgement of the importance of research and development to the NHS, and the importance of research within the NHS. It is hoped that this view will become widely accepted and supported by NHS management. The universities also play an important part in UK medical research: indeed, the science base in the universities underpins the research funded by charities.

3. *What are the relationships connecting government funding of the science base, funding by industry and charities, and overseas funding? Various people are "paying the piper": are they calling different or incompatible tunes, and if so is this a bad thing?*

3.1 Medical research charities exist with the primary purpose of improving health through supporting research: an aim which is in the public good and is purely philanthropic. Their purpose in funding research is not for corporate or individual gain but to prevent or cure disease and ease human suffering. New medical research charities are established every year, many of them tackling diseases which have only recently attracted wider public interest, for example incontinence, Alzheimer's Disease, primary immunodeficiency. There are several hundred charities but the range of their activities is limited by the terms of their individual constitutions.

3.4 Medical research charities support research in a variety of ways: project and programme grants, fellowships, pump priming and occasionally entire units or departments (see Chart 1). The work which they support is undertaken largely in institutions which are themselves funded mainly from government sources: Higher Education Institutions (HEIs) and NHS hospitals (see Chart 2). Within these institutions charities rarely direct or commission research: their contribution is largely in the form of responsive support for research for which HEIs or their staff seek funding. Such support is substantially different from commercially commissioned or funded research.

3.5 It should not be forgotten that individuals who are funded by charities to do research also undertake teaching and other responsibilities within HEIs and clinical duties within the NHS. For example, the Wellcome Trust allows academic research fellows to spend up to 30 per cent of their time undertaking university teaching and other academic commitments; and the charities support very substantial numbers of clinicians of all grades, the majority of whom undertake NHS service duties either related to their research or in addition to it.

3.6 The Government will be aware of the enormously important, indeed crucial, role that charitable funding has provided for university-based medical research, especially in recent years. The UK pharmaceutical industry is one of the strongest sectors in the economy: it too benefits greatly from the broad scientific base for medical research which has developed under the present funding mechanisms. Specific benefits are that the pharmaceutical industry is able to recruit research personnel from a large pool of trained researchers, many of whom will have been supported by charities earlier in their careers and also are able to exploit ideas which were first developed as basic research funded by charities.

3.7 Charities are now the principal source of funding for research into many disease areas; they fund both applied research and research into areas of basic biomedical science valuable to all medicine. Even amongst single disease charities more than half of their research support can be in fields of basic medical science.

3.8 However, charities are crucially dependent upon an infrastructure in both the higher education institutions and the National Health Service in which they carry out their research. Whilst the public, through the charitable sector, can and does play a major role in the support of basic and clinical medical research, it cannot and will not accept the further burden of funding the infrastructure which underpins research and which it believes should be supported from Treasury sources.

3.9 In the view of the Association, the government takes for granted that the funds available from charities will continue to support the science base in universities. Medical research charities support good research in UK universities which in the past has been based on a strong science base and a well-funded infrastructure. Charities do not have to support research in universities and many members of the Association would be willing to consider funding research in other institutions if UK universities were no longer able to sustain a strong and stable medical science base.

3.10 In this context it should be noted also that many UK medical research charities, including the Wellcome Trust, are free to support medical research anywhere in the world. The Association believes that the Government would be unwise to rely on the charities to provide so much of the basic research funding in universities.

4. *What information and advice is needed by those who are setting priorities? How do they know what is going on in current low priority fields? How do they track developments overseas?*

4.1 The Association's principal concern is the fragmented way in which decisions regarding the medical science base are made and which create the environment in which charities must operate. There has appeared to be a lack of consultation in planning and co-ordination of research policy during a period of major change in both the NHS and higher education. There is little evidence to suggest that an overall research strategy links various government programmes. The charitable sector has rarely been consulted or involved in discussions at an early stage. The Association would wish to see research needs considered in a wider environment, particularly in the NHS and has welcomed the establishment of the Research and Development Division and the appointment of its Director.

4.2 The Association hoped that with the establishment of an Office for Science and Technology there was an opportunity to consider the needs of research at every level of planning and at a practical level. The Association would like to see the establishment of a standing committee which would bring together those sectors with an interest in UK medical research. Those with interests in UK medical research are rarely brought together and as far as we are aware this has never been achieved at the initiative of government. We are aware of many bilateral discussions involving just government departments or government funded agencies. An example of this is the MRC and Department of Health Concordat, regarding research in the NHS: no such consultation has taken place with the charitable sector which is of equal importance in UK medical research.

4.3 The charities value opportunities for collaboration with others. The Association has worked with the Medical Research Council to develop a closer working relationship in recent years as also have individual charities. The bodies share many concerns and contact between the organisations is regular although mainly informal in nature.

4.4 In spite of the fact that medical research in the UK is a partnership between HEIs, charities, industry and government thinking about the needs of medical research at government level appears to consider only the needs of government funded agencies and not the wider environment. The charities seek more formal recognition of their role and an input into decision-making.

International Links

4.5 Member and affiliated charities within the Association use peer review in the allocation of grants and awards for research. In this process, many charities seek the advice of overseas referees and the Association believes that this helps to minimise unnecessary duplication of research. Charities encourage also the dissemination of research they have funded and most will provide funding for researchers to attend appropriate international conferences. Many charities organise or fund international conferences and workshops on particular diseases or areas of research. In addition, the charities themselves often have extensive international networks and many have been involved in collaborative projects with overseas research organisations and charities.

5. *How do charities and companies which fund research set and implement priorities?*

5.1 The funding strategies of the charities and the Medical Research Council overlap to a certain extent and are also complementary. There are, however, important differences between the MRC and the research charities. The aim of the MRC is to sponsor research which will improve the health of individuals in the community. The MRC particularly identifies among its major national areas of responsibility: (a) investment in long-term basic research (largely carried out in its institutes and units); (b) identifying and supporting the most gifted individuals; (c) the provision of resources for training. The charities have an important but proportionately smaller commitment to basic and long-term research and they retain a larger proportion of their funds for shorter term projects. The charities have a great deal of flexibility and these short-term grants serve two main purposes; they provide seed money to test the feasibility of new ideas and new techniques and they also provide funds for clearly defined projects of limited duration.

5.2 In response to changing needs within the research environment, charities are giving consideration to providing more longer term support. Because of the largely unpredictable way in which fund raising charities receive their money, it is difficult for all to do so, but the very large charities are considering what additional schemes they might be able to support.

5.3 A substantial majority of the charities raise funds which are donated for a specific purpose and are dedicated to research into a single disease or group of related disorders. Such charities raise their funds directly from the public, and the amounts raised reflect the public's perception of the relative importance of these diseases. This is the only mechanism by which the public can have a direct influence on the distribution of research resources, and this is of particular importance. It does, however, have some limitations. The foundations, which exist as a result of corporate or private philanthropy are able, to a certain extent, to play a complementary role. These bodies are less restricted in their range of activities and are able, in addition, to include basic medical science and to support those areas which do not command public interest and which would otherwise be neglected by the charities. It must be stressed that the range of activities which an individual charity can undertake is determined and limited by its constitution.

5.4 Advances of practical importance in the biomedical sciences have their roots in basic research. The provision of adequate resources to support excellent fundamental research is therefore an essential prerequisite for continuing progress towards better health care. The history of the biomedical sciences shows that many of those lines of basic research which have ultimately led to major progress have not been recognised as such in advance. The problem is that there is no way of knowing in advance which fraction of the monies invested will lead to progress in prevention, diagnosis or therapy, at least in the short or medium-term. This is the nature of basic research. Supporting basic research is thus a question of taking a calculated risk. There is a feeling, certainly within the charities, that the flexibility and broad base of the charitable sector may mean that it is able more easily to undertake this risk than government.

5.5 The major priority must be to provide adequate support for basic research to increase the knowledge base upon which all other research depends. It is also essential that this support should be directed towards identifying, training and providing opportunities for those individuals with the talent and motivation to do original and innovative research. It is rarely realistic or practicable to set priorities for basic research since the process is science-led.

5.6 It is only with an adequate and developing knowledge base that a serious consideration of priorities for strategic and applied research is practical, for example:

(a) the major effort to identify the genes for a number of single gene disorders (for example, Duchene muscular dystrophy and cystic fibrosis) has only been possible because of advances in gene identification techniques;

(b) the research on AIDS which draws heavily on earlier fundamental work on the retroviruses;

(c) the basic work on oncogenes and tumour suppressor genes is now promising a rational understanding of the cancer process and will ultimately lead to new therapies.

5.7 The determination of priorities also depends upon additional factors which include health needs, the availability of trained personnel and sufficient resources.

5.8 A plurality of sources of funding (including the MRC and the individual charities, industry and government departments) is beneficial to the science community and has produced an outstandingly strong environment for medical research in the UK. In particular, the partnership between government and charities in supporting research in HEIs has been an important factor in developing the breadth and strengths of university medical research.

6. *What are the objectives and priorities of the HEFCs in funding university research through block grants, and who is setting them and on what basis?*

6.1 The Association believes that the government, through the funding councils, should continue to provide financial support to universities to underpin peer reviewed research funded by charities.

7. *How is each university's block grant distributed between departments, and on what basis?*

7.1 The Association is concerned at how the block grant distributed to individual institutions is then distributed to individual departments and research units within the institutions. The Association hopes that individual HEIs will work towards a transparent and accountable merchanism.

7.2 The Association welcomed the opportunity to participate in the recent Research Assessment Exercise undertaken by the funding councils. It is hoped that future exercises will endeavour to establish agreed ground rules in order to achieve greater consistency in the criteria for input of data and in the assessments. Within the field of medical research the charities provide considerably more financial support to universities than do the research councils and the Association would hope that this importance will be fully recognised in future assessment exercises.

7.3 The Association hopes that the methodology for allocation of funding based on research rating will not impede the number of excellent but relatively small research units and groups working within larger lower rated departments and schools.

Research Councils

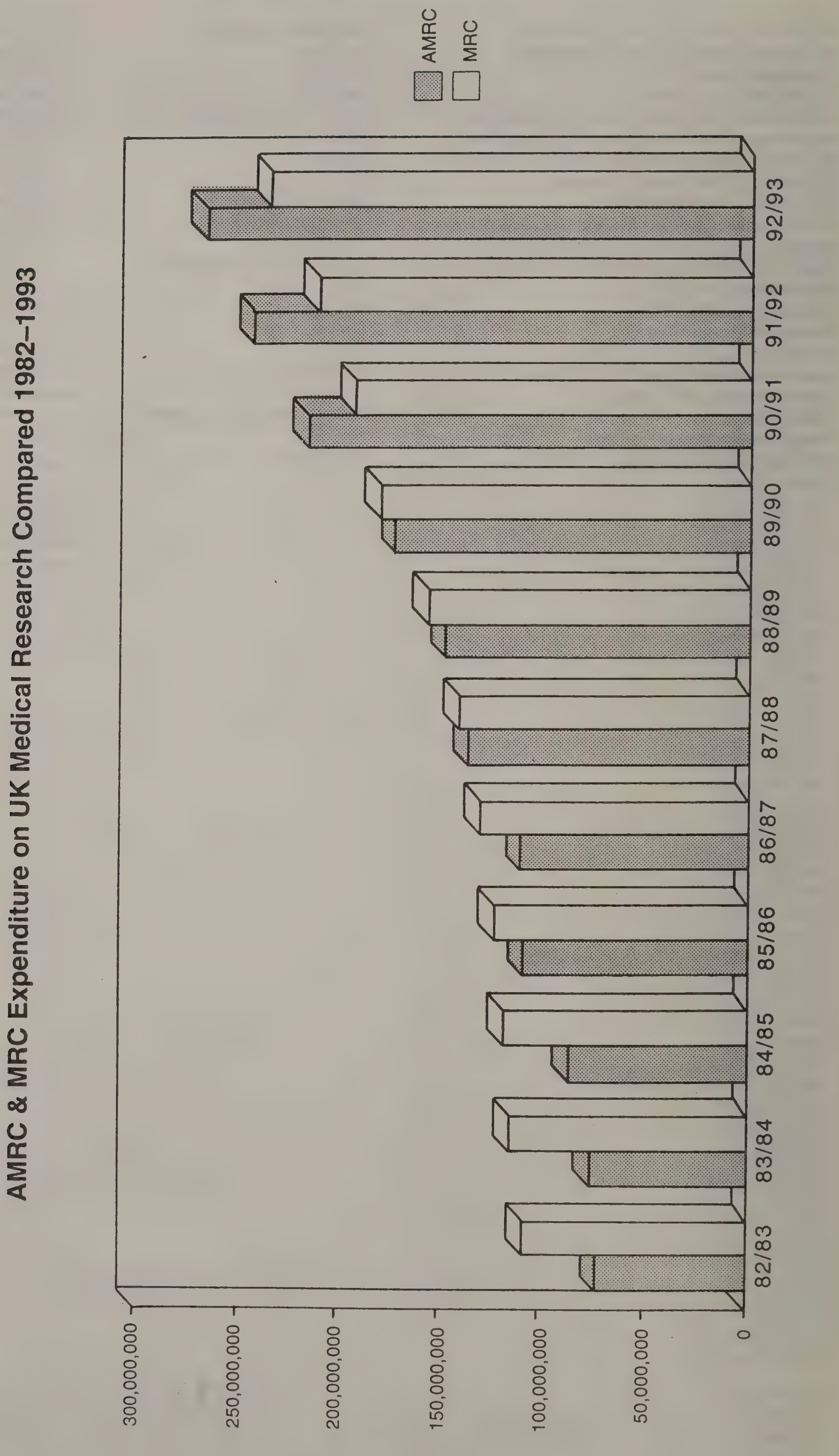
8.1 The medical research charities welcome opportunities to collaborate with the research councils and in particular with the Medical Research Council. The Association itself has developed closer working with the MRC and in addition to formal contact there is regular exchange of information and contact between officers. Such contacts have helped to foster closer collaboration and co-operation in a number of areas.

TABLE 1

MEMBERS' AND AFFILIATES' EXPENDITURE ON BIOMEDICAL RESEARCH

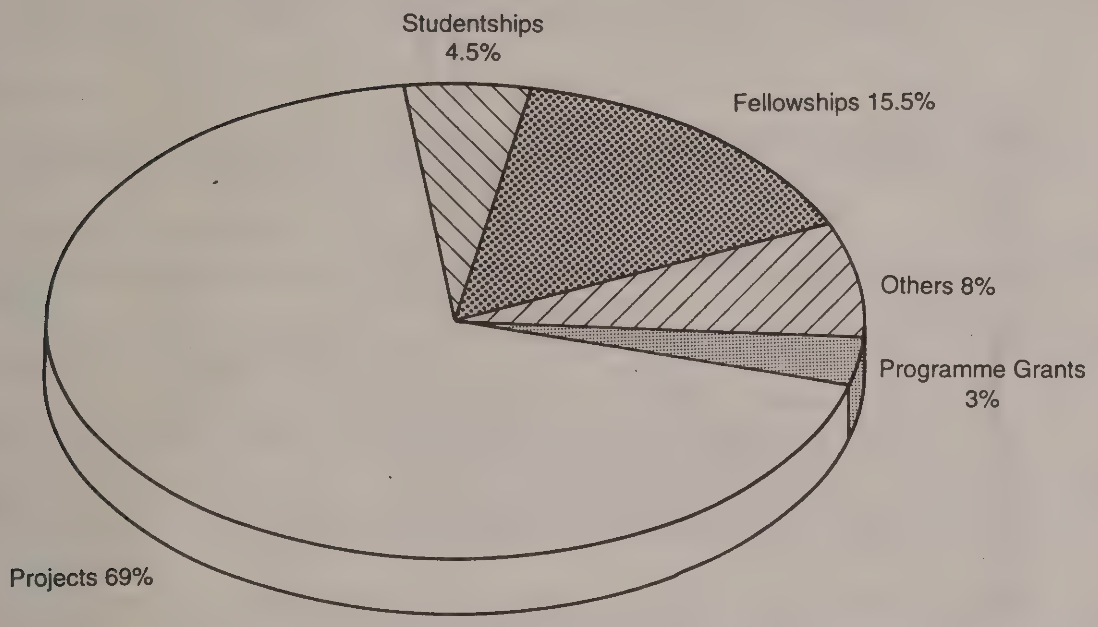
Name	*Scientific Area*	*Expenditure Total*
Wellcome Trust	General	£77,231,000.00
Imperial Cancer Research Fund	Oncology	£49,932,000.00
Cancer Research Campaign	Oncology	£44,199,000.00
British Heart Foundation	Cardiology	£20,943,697.00
Arthritis and Rheumatism Council for Research	Rheumatic Diseases	£11,800,000.00
Leukaemia Research Fund	Leukaemia	£9,053,201.00
Yorkshire Cancer Research Campaign	Oncology	£4,845,158.00
Multiple Sclerosis Society	Neurology	£4,700,000.00
Ludwig Institute for Cancer Research	Oncology	£4,490,000.00
Action Research	Medical Research	£3,500,000.00
British Diabetic Association	Endocrinology	£2,631,780.00
Muscular Dystrophy Group	Neuromuscular	£1,931,117.00
Sir Jules Thorn Charitable Trust	General	£1,874,000.00
National Asthma Campaign	Asthma and Related Allergy	£1,829,009.00
Cystic Fibrosis Research Trust	Digestive/resp	£1,644,300.00
Marie Curie Cancer Care	Oncology	£1,490,000.00
Ciba Foundation	General	£1,380,519.00
North of England Cancer Research Campaign	Oncology	£1,319,327.00
William Harvey Research Institute	Cardiovascular Inflammatory	£1,161,720.00
Birthright	Obstetrics	£1,100,000.00
Parkinson's Disease Society of the United Kingdom	Neurology	£1,093,174.00
British Lung Foundation	Respiratory	£1,044,141.00
National Kidney Research Fund	Nephrology	£1,010,000.00
Stroke Association	Cardio/respiratory	£959,247.00
Wessex Medical Trust	General	£925,854.00
Tenovus Cancer Fund	Oncology	£924,664.00
Motor Neurone Disease Association	Neurology	£900,000.00
Mental Health Foundation	Psychiatry	£834,680.66
Leverhulme Trust	General	£823,700.00
Lister Institute of Preventive Medicine	Study of Diseases	£762,000.00
Brain Research Trust	Neurology	£721,436.00
Nuffield Foundation	General	£499,670.00
Spastics Society	Cerebral Palsy	£450,000.00
Liver Research Unit Trust	Hepatology	£389,205.00
Foundation for the Study of Infant Deaths	Paediatrics	£386,026.00
Iris Fund for the Prevention of Blindness	Ophthalmology	£342,140.00
Research into Ageing	Geratology	£340,173.00
International Spinal Research Trust	Neurology	£320,000,00
Royal National Institute for the Blind	Ophthalmology	£265,000.00
British Retinitis Pigmentosa Society	Ophthalmology	£254,927.00
British Digestive Foundation	Endocrinology	£225,000.00
Blond Mcindoe Centre for Medical Research	Immunology	£219,480.00
Smith and Nephew Foundation	General	£217,000.00
Living Again	Disabilities	£143,461.00
Remedi	Medical Disability	£68,000.00
Migraine Trust	Neurology	£56,542.00
National Back Pain Association	Muscular/neuro	£46,117.00
Association for Spina Bifida and Hydrocephalus	Neurology	£31,363.00
		£261,308,828.66
Scottish Hospital Endowments Research Trust	General	£850,000.00
Guide Dogs for the Blind Association	Ophthalmology	£540,000.00
Wishbone Trust	Bone and Joint Surgery	£500,000.00
Cancer and Leukaemia in Childhood Trust	Oncology	£389,000.00

Restoration of Appearance and Function Trust	Restorative Surgery	£381,795.00
Bradford's War on Cancer Campaign	Oncology	£238,000.00
Hearing Research Trust	Hearing	£219,551.00
Friedreich's Ataxia Group	Neurology	£200,000.00
Chest, Heart and Stroke Association Scotland	Cardio-vascular System	£199,298.00
Beit Memorial Fellowships for Medical Research	Medicine	£197,802.00
DEBRA: Dystrophic Epidermolysis Bullosa RA	Genetics	£188,849.00
Children's Liver Disease Foundation	Hepatology	£180,498.00
TFO Frost Charitable Trust	Ophthalmology	£163,304.00
Tuberous Sclerosis Association of Great Britain	Neurology	£120,000.00
British Council for Prevention of Blindness	Ophthalmology	£118,801.00
Bardhan Research and Education Trust	Gastrointestinal Diseases	£115,000.00
Psoriasis Association	Dermatology	£66,555.00
Barnwood House Trust	General	£50,000.00
National Eczema Society	Dermatology	£38,237.00
Brain Damage Research Trust	Neurology	£35,000.00
Mason Medical Research Foundation	General	£33,658.00
Royal Surgical Aid Society	Surgery	£15,500.00
Little Foundation	Pre-natal Neuro-development	£4,454.00
Breakthrough Breast Cancer	Oncology	
Primary Immunodeficiency Association	Immunology	
		£4,845,302.00
		£266,154,130.66



AMRC & MRC Expenditure on UK Medical Research Compared 1982–1993

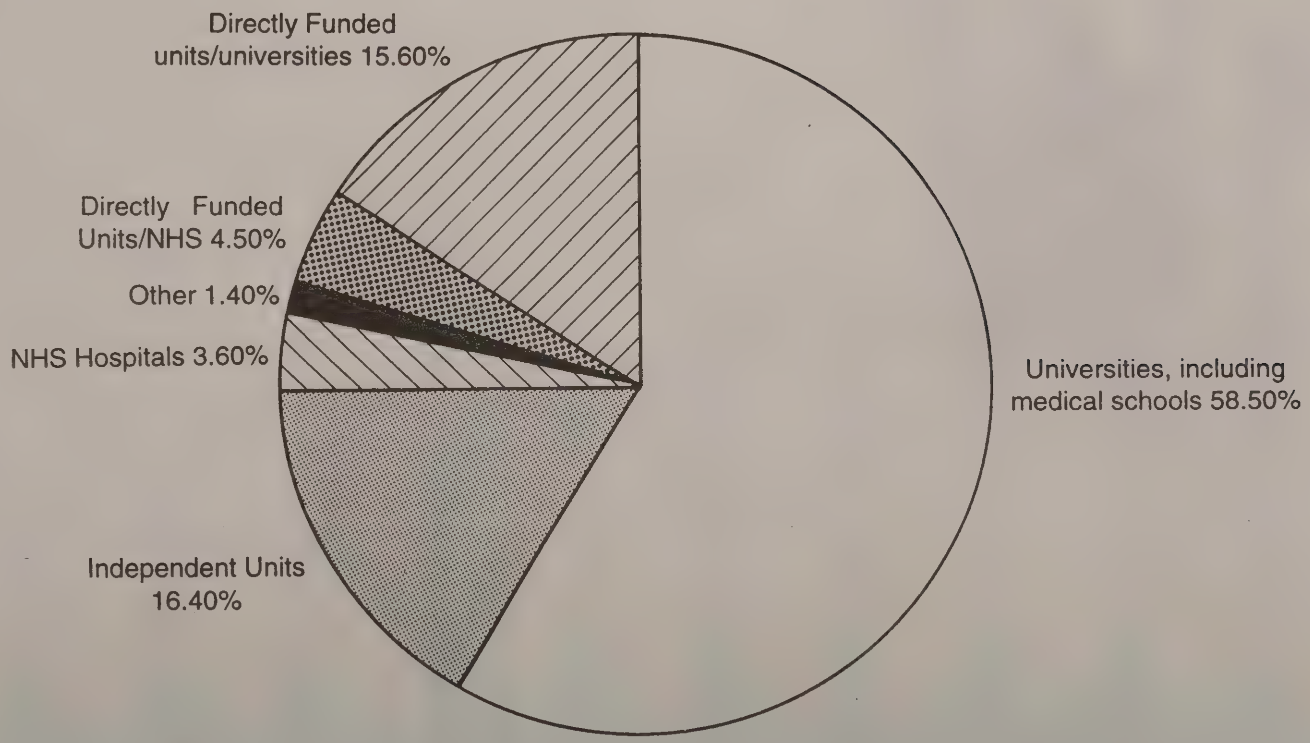
Types of Grants Awarded by AMRC Charities



Total Number of Grants, 1990 and 1991 = 2910

Not included: grants awarded to charities' own institutions

Distribution of AMRC Funding for Medical Research in the UK



Letter and Memorandum from the Association of Researchers in Medicine and Science Ltd

On behalf of the Association of Researchers in Medicine and Science (ARMS) I have pleasure in submitting written evidence prepared by the Executive Committee for consideration by the Select Committee on Science and Technology.

We regret that the inquiry will not cover academic research careers—or rather the lack of them. It is our contention that it is this single factor which is the greatest disincentive to the recruitment of the talented and innovative minds which are central to the success of any of the points listed for discussion.

Dr H Anne Simmonds

29 *April* 1993

The Association of Researchers in Medicine and Science (ARMS) submits the following points in answer to questions posed by the inquiry:

1. *What is public expenditure on the Science Base for?*

1.1 ARMS wishes to draw attention of the Sub-committee to the following aspects of the Science Base funding:

1.1.1 The training of researchers: the quality of researchers available is a powerful factor in determining the effectiveness of research expenditure.

1.1.2 It is ARMS' contention, not seriously disputed, that the science graduate rarely becomes a mature independent researcher within 5 years of graduation, even with full-time research/training.

1.1.3 It is also ARMS' contention that too many promising researchers are blighted or become disillusioned by too early exposure to high pressure and high priority research areas, however superficially exciting such areas may be. Additionally, there is too great a temptation to use research students as cheap technical assistants.

1.2 For these reasons, ARMS wishes to draw attention to the use of the Science budget. Substantial continuing allocations must be made to research training and these must neither be particularly project-oriented nor for "high priority" fields.

1.3 These allocations must be made to active researchers with commitment to good research training and must allow and encourage the intellectual and technical skills required of a good researcher to develop in tandem. It is inevitable that well-trained researchers will create their own active field or move to the challenge of currently active fields. Thematic mobility during sustained careers is another hallmark of the good researcher and is strongly advocated by ARMS.

2. *What are the objectives and priorities of the various funding agencies within Government?*

2.1 ARMS contends that a foremost priority of the various funding agencies within Government must be provision of a coordinated and rational training structure for the researchers. At present this is not being provided, as the funding agencies, in their perception of Science as a "problem-oriented" activity, are failing to recognise the primary importance of the researchers themselves, whose role may be not only problem-solving, but instigating new areas of research activity which were not previously perceived by the funding bodies.

2.2 A more general remark may be made about the effect of continuing revision and uncertainty in the control of funding of the Science Base: ARMS suggests that such instability frightens people away from commitment to scientific research, which by the very nature of the activity is uncertain enough.

2.2.1 In addition, ARMS is informed that industry and pharmaceutical companies, both at home and abroad, are loth to sub-contract research to UK universities because the uncertainty engendered by the lack of continuity in the existing system creates doubts as to the quality of the researcher, and hence the work done, as well as the ability to meet agreed completion targets.

3. *What are the relationships connecting Government and other funding of the Science Base?*

3.1 ARMS recognises that the relationships connecting funding of the Science Base by Government, industry, charities and overseas agencies are inevitably based on very different priorities. Charities and industry have been centrally concerned with problem-oriented research, and as such their funding is percieved as being directed solely towards exploitation of the Science Base to resolve specific self-interested questions. In contrast, ARMS contends that Government should be concerned particularly, but not solely, with the training of researchers, and with funding that is neither project-oriented nor aimed at areas that are perceived as "high priority".

3.2 However, ARMS contends that the various agencies that have been "paying the piper" have been calling very incompatible tunes. Several charities are now taking more responsibility for their research staff, but both the universities and industry continue to deny that the training and fate of researchers is important to research itself.

3.3 Government, while not having a direct interest in the fate of researchers once their training has been completed, has nonetheless failed in a role that it is well-suited for: that of bringing together the interested parties contracting research to analyse their policies on researchers. Instead, Government has continued to deny its relationship to agencies receiving funds from it, in particular the universities, by stating that the policies of universities to their researchers is solely "a matter of the universities".

3.4 Similarly, Government has failed in the role of intermediator between researchers and industry, in that it is in a unique position to encourage industry to consider the advantages of incorporating researchers into executive or other decision-making positions.

4. and 5. essentially follow each other being concerned with setting and implementing priorities, but appear to worry more about what is going on overseas:

4.1 The sub-committee should be encouraged to recognise the following:

4.1.1 A nation cannot lead by aping others, especially when there are great differences in culture, work practice and education involved;

4.1.2 The concentration on "fashionable" (ie priority) research is regrettable. This relates to two opposing characteristics in priority setting in the UK: resistance to change, and lack of appreciation and support of Britain's innovative scientists whose novel ideas have consequently been taken up and exploited elsewhere;

4.1.3 A proportion of the Science Budget should thus be specifically earmarked for seemingly unfashionable ideas in "low-priority" areas.

4.2 Given the stated interest in overseas developments, the committee should bear in mind that charities and companies operate abroad as they do in Britain, but the important difference is that in other European countries, eg France, science and scientists have status.

In conclusion, ARMS stresses that the Sub-committee must keep in the forefront of their minds the effect of their recommendations on recruitment and training, which may take 5-10 years to appear and, if poorly appraised, a further generation to rectify.

Memorandum from British Aerospace

British Aerospace welcomes the opportunity to submit evidence to the House of Lords Select Committee on Science and Technology enquiry by Sub-Committee I into how priorities are set and implemented for the UK Science Base. We recognise that the great majority of the questions posed by the Committee are aimed at the various agencies within the Governmental and Academic Systems and therefore we have chosen to make only a brief submission, focusing on the overall policy for prioritisation and the specific questions which the Committee addressed to industry.

Question 1

"What is public expenditure on the Science Base for?"

This is a fundamental policy question which has been addressed recently in the White Paper "Realising Our Potential". British Aerospace fully supports the major themes of that policy document. Notwithstanding the risk of repeating some of the aspects already covered in the White Paper, the issues are important and justify a restatement of our views.

We believe that one key objective for public expenditure investment in the Science Base should be to foster the creation of UK wealth. Much of the Science Base makes an important contribution to the long term technology investment which is needed by industry if it is to be competitive in world markets and so to contribute to UK economic growth. In the current UK economic climate and culture, it is very difficult for industry to justify the use of shareholders' funds for such speculative, long term investment. We believe that the State has a dominant role to play in supporting the Science Base and that wealth creation should be a prime objective of this support.

A change of culture and perception in the UK towards Science and Technology is needed if proper weight is to be given to the objective of wealth creation. Technology, and the science to feed technology, should be given greater emphasis and priority. We believe that appropriate industrial representation on the various policy setting councils and boards would greatly facilitate this process.

The above approach should not be interpreted as proposing that University research should move closer to market but rather that the need for wealth generation should more strongly influence the choice of priorities between different areas of research. For example, priority might be given to areas such as structural materials and software methodology rather than particle physics and big science. This approach would be appropriate both for curiosity driven research, performed by high quality elite staff, and the more focused research which is related to the longer term interests of industry. It is suggested therefore that this re-balancing could be brought about by a combination of industrial involvement in selection and prioritisation and by incentives to encourage Universities to re-balance their work programmes.

A healthy, targeted investment of public expenditure into the Science and Technology Base is a necessary but, by itself, not sufficient condition to ensure a competitive industrial performance. Although outside the scope of present enquiry, we would draw attention to the need to consider the whole innovation process by relating the activities of the Science Base to the Applied Research, Technology Demonstration and Development activities of Industry. The creative nature of work in the Science Base is important but it also needs to be given direction and focus through an industrial involvement.

The current BAe approach to company investment in the Science Base is given below in our response to Questions (a) and (b).

Industry Questions (a) and (b)

"What are you putting into the Science Base, getting out of it and whether this meets your expectations?"

British Aerospace contributes to the UK Science Base by using several mechanisms which cover both research and training. For example, BAe directly funds Chairs, Lectureships, Studentships, research work and supports in kind through the provision of visiting professors, staff exchange, course development, facilities etc. Long term relationships have been established with specific Universities to cover these activities. BAe also sponsors "Centres of Excellence" in selected technical areas as another form of long term partnerships between Industry and University.

The BAe Sowerby Research Centre contributes to the UK Science Base both through its in-house programme and by interacting with university research. It is tasked with accessing the results of university research and with building on these results to provide the mature, proven technologies needed by the Operating Companies of BAe. As such, Sowerby often carries out an intermediate role, working closely with the universities and adding value to their output. In many cases, this collaboration takes the form of participation in grant-aided projects under UK and CEC schemes (LINK, ESPRIT, etc). At present, there are 20 such projects being undertaken, involving 32 universities in the UK and the rest of the EEC.

The Operating Companies of BAe also have substantial direct links with chosen universities, often participating directly in collaborative projects.

By the above means, which represented a total investment of some £8 million in the HEIs in 1992, BAe influences the choice of areas of research undertaken by the Universities to be those that are relevant to the needs of the company. This, however, is carried out independently to the main support from Her Majesty's Government to the Universities. As discussed in our response to Question 1, we believe that a better recognition and incorporation of the priorities of UK Industry would enable most UK companies to draw a significantly greater benefit from the research carried out in the Science Base.

Memorandum from British Gas plc

As a technologically based company with a strong R&D capability, British Gas has a wide range of contacts with university departments of science and engineering across a broad front.

We look to the universities for much of the generation of new scientific knowledge in areas of long-term importance to us, which can in due course be translated into improvements in our own operations, equipment used in the gas industry, etc. This is facilitated by close working relationships between our own R&D staff and experts in universities in areas of mutual interest. We achieve this through a variety of mechanisms, including support of Research Fellows and of postgraduate research students in longer-term areas of relevance to our business. We also fund contract research of a shorter-term nature, where we have a limited need for specific expertise and/or specialist equipment which we cannot, at the time, justify having in-house. This is often done with departments with whom we already have longer-term research relationships.

Equally importantly, we look to the universities as a source of intellectually capable and appropriately trained people in science and engineering, who can add value to the company from within, both as research workers and, subsequently, in senior positions in other parts of British Gas.

Thirdly, the university sector constitutes an invaluable intellectual forum, which provides a means of keeping industry abreast of new developments in science and technology.

We feel that it is the government's responsibility to maintain and foster the science base as a source of new knowledge and of capable, trained people. We contribute indirectly to the process through payment of taxes, etc, and directly through our support of collaborative research and of research training, in some cases in conjunction with bodies such as the Royal Society and the Royal Academy of Engineering and, in others, with government agencies (eg, SERC) and departments (eg, the DTI). Increasingly, of course, we are also participating in EC collaborative programmes, involving non-UK higher education institutions.

Finally, we would comment that although the trend towards concentration of resources in specific areas and institutions is inevitable—given the high cost of research and the need in many cases for an interdisciplinary approach—we would not like to see the process go too far, since that would stifle or prevent initiatives and ideas from new and unexpected sources, which could themselves lead to major advances (an example being liquid crystal technology).

Memorandum from British Telecom

1. *What is public expenditure on the Science Base for?*

Expenditure is for providing a basic scientific infrastructure. This should be a structured balance between fundamental, strategic and applied research with government deciding the amount of funding for each type of research within specific sectors. Public expenditure on the science base should enable industry to concentrate on applied research and direct clear benefit towards wealth creation and improvements in the UK socioeconomic infrastructure.

2. *What are the objectives and priorities of the various funding agencies within government?—Research Councils, HEFCs, other departments. Are they related? Is an overview required, and do the existing structures (ABRC, ACOST, OST) provide it?*

The objectives and priorities of the various funding agencies were not well delineated prior to the recent White Paper. An overview was certainly needed and the White Paper has made improvements. BT believes that the funding provided by the DTI, the Research Councils and the Ministry of Defence need further co-ordination. With nearly 50 per cent of the Government's research budget going for military applications there need to be much closer links between MOD and civil researchers to avoid duplication and maximise benefit to industry. Another example of unclear responsibility is in the increasingly important topic of Information Technology, where responsibilities are still shared between the EPSRC and the DTI.

3. *What are the relationships connecting government funding of the Science Base, funding by industry and charities, and overseas funding (particularly from the EC)? Various people are "paying the piper": are they calling different or incompatible tunes, and if so is this a bad thing?*

Government should have a well-defined and co-ordinated strategy towards funding its research. The government's strategy should take into account funding from, and general industrial strategy within Europe. Government should also take into account the views of industry as to which research areas are most appropriate for government to fund, and which are more relevant for industry to fund. The recent White Paper has addressed these issues for the first time.

4. *What information and advice is needed by those who are setting the priorities? How do they know what is going on in current low-priority fields? How do they track developments overseas?*

The government should set priorities between the different categories of the science base (see 1 above) in the light of economic, social and political circumstances.

Where funding is directed toward topics with commercial potential, particular attention is needed on the process and opportunity for the work to be exploited. There need to be mechanisms in place to facilitate all stages of the innovation process from science through technology to manufacturing, marketing and sales. Unless there is a feasible route, the funding of the science base will not be used to maximum benefit.

One factor determining the likelihood of commercial success is the activity and competitiveness of foreign industries and a continual monitoring and analysis of these activities should be funded, and the conclusions acted upon. Government should have a more proactive involvement with this sort of activity and be able to make positive decisions as to which areas should specifically not be funded in the UK because of the likelihood of unassailable competitive pressure from elsewhere.

5. *How do charities and companies which fund research set and implement priorities? How is it done overseas? Are there lessons here for the Government?*

BT's research and development is related to its business as a network operator and telecommunications service provider. Of the £233 million spent last year on research and development, £55 million was spent on activities the results of which are anticipated to be exploited in the 3 to 10 year time frame (corporate research). £3.6 million was spent with universities.

BT does not fund fundamental research, but directs its long-term research towards possible applications judged to be relevant to its future business. It sees fundamental research as primarily the responsibility of the science base, with industry funding work once possible applications can be identified.

Priorities for BT's corporate research are set by a group chaired by the Board Member responsible for Development and Procurement, and are influenced by the requirements of the operating divisions and the need for the company continually to improve its competitive position.

Universities

6. *What are the objectives and priorities of the HEFCs in funding university research through block grants, and who is setting them and on what basis?*

HEFCs allocate funding to universities based on their research ratings. These ratings are weighted strongly towards quality of research, rather than being influenced by the ability to exploit the research. It would be desirable to have a measure that reflected the "usefulness" of the research work (ie a demonstration of commercial opportunity or industrial approval) and the allocation of some of the funds should be based on this measure.

7. *How is each university's block grant distributed between departments, and on what basis?*

No response.

8. *What are the impacts on priority-setting of—*

- (a) *the abolition of the binary divide*
- (b) *the shift of emphasis from core funding to project funding involved in the transfer of £150m p.a. from the HEFCs to the Research Councils*
- (c) *the regionalisation of funding*
- (d) *formula-funding, research rating and moves towards an R-T-X model?*

No response.

Research Councils

9. *The Research Councils have explicit missions. How are these translated into priorities, by whom and on what basis?*

No response.

10. *How are the competing priorities of the different Research Councils (and the Royal Society and the Royal Academy of Engineering) reconciled within the limits of the Science Budget?*

No response.

11. *Are the priorities of the Research Councils skewed by the boundaries between the Council's remits, by the existence of Research Council institutes, by international obligations to support "big science", or by anything else?*

No response.

12. *How is the money transferred from the UFC to the Research Councils being spent?*

No response.

30 *June* 1993.

Letter from Celltech Research Ltd

I am writing in response to your call for evidence which you require prior to 30 June 1993. Since its foundation in 1980, Celltech has had close working relationships with academic researchers in Universities and Research Councils. Our initial approach was to fund Biological Research in a broad and fairly indiscriminate nature in the hope that "something will turn up". For the most part this approach was unproductive from an industrial point of view in terms of commercially exploitable discoveries. At its peak in 1988–89 our external funding accounted for almost 15 per cent of our total research spend.

During the past two years we have rethought our funding policy. We have taken the decision to invest more heavily in our own in-house research and to fund external research which is synergistic with our own efforts. In particular we have sought to identify academic expertise which is missing in our own organisation so that the interaction between the academic and industrial laboratory can be more productive.

Since our total investment in academic research amounted to £588k in the last financial year, I thought that your might be interested in our replies to question 3 and question 5 which have been prepared by my colleague, Dr Gerald Lilley.

Overall, the point that I would make is that our industrial approach has to be opportunistic. We rely upon a well funded and varied academic research base to complement our own efforts. We particularly look for skills and approaches that we do not already possess. In the area of Biological Research, I would say that we have been somewhat disappointed in our efforts at collaboration in the past few years. The main reasons for this are as follows:—

(1.) The relative position of academic laboratories in UK biology has slipped. Many of our collaborations are now with laboratories in continental Europe and the USA.

(2.) Academic researchers are still not fully aware of the possibilities that arise from patenting their inventions ahead of publishing their data. When patents are made, there is too much focus on up front payments (short term profit) rather than royalties (long term profit and shared risk).

I do hope that our comments will be of some use to the Committee.

DATA TO SUPPORT ANSWER TO QUESTIONS 3 AND 5

3. The Celltech experience of funding the UK Science Base and its meshing with Government funding is given below:

3.1 Postgraduate research training with Government support through the Science and Engineering Research Council (the Co-operative Awards in Science and Engineering scheme). Amounting to a financial commitment by Celltech of £40,000 for academic year 91/92.

3.2 Precompetitive research with Government support through the Science and Engineering Research Council and the Department of Trade and Industry (LINK scheme and Co-operative Awards). Amounting to a financial commitment by Celltech of £200,000 for the academic year 91/92.

3.3 Direct support to University Departments for strategic and project specific work (without support from Government bodies). Amounting to a financial commitment by Celltech of £240,000 for the academic year 91/92.

3.4 An undergraduate award scheme (without support from Government bodies) amounting to £4,000 for the academic year 91/92.

3.5 Support to consultants and Science Council members amounting to £50,000 for the academic year 91/92.

3.6 A Celltech Fellowship award to the Laboratory of Molecular Biology of the Medical Research Council amounting to £42,000 for the academic year 91/92.

Celltech supports, with Government sponsorship, the training of research scientists and pre-competitive research. Additionally and at its own expense Celltech supports strategic and project specific research through one to one collaborations.

5. To maintain a competitive advantage Celltech assesses the opportunities that arise in its chosen areas of activities and refines its focus and applications of resources accordingly. This process leads to priority setting and changes in emphasis. This rapid response to changing circumstances, the hallmark of a small high technology company, is not well matched by the Government grant awarding bodies.

Dr David P Bloxham
Director of Research

6 *April* 1993

Exchange of letters between the Clerk and Professor Peter Dunnill

Lord Flowers has asked me to follow up a matter which arose during the visit to UCL yesterday morning by the Sub-Committee on Biotechnology. I gather that Lord Flowers asked why such apparently "near-market" work on pipe leakage was being conducted at a university with research council money, rather than in an industrial laboratory with industrial funds, and was told that it was because the investigation of leakage of genetically modified material raised fundamental scientific questions about the nature and behaviour of the material.

Lord Flowers is interested in this matter not only in the context of the Biotechnology enquiry but also in connection with the Committee's other enquiry into Priority Setting for the Science Base. I enclose a note explaining in more detail what this enquiry is driving at. In this context he would be very grateful for more details of the origins and funding of your work on leakage, and of how it squares (or not) with the conventional linear model of basic, strategic, applied and near market research.

I look forward to hearing from you on this subject. If you wish to address any of the wider questions in the Committee's Call for Evidence, you are of course free to do so.

29 *April* 1993

Thank you for your letter of 29 April.

Firstly, to put the issue in perspective, the specific research on release of microbial cells is the work of an SERC CASE student (we have 33 full time PhD students), and one research staff member funded by the HSE. We focused on it disproportionately during the visit because of the nature of the Sub-Committee's interests.

The particular research has several components which entail inputs from different disciplines. The first need is to be able to collect microorganisms and quantitate their recovery. The many potential methods of collection each affect the viability of the organism in different ways. Secondly, there is a need to generate standard aerosols as a base line and their characteristics are governed by the methods used in ways which are poorly understood. The state of the organism is subsequently greatly affected by the conditions in the air. Finally, the organisms must be quantitatively detected. Methods which rely on growth will not detect organisms which are non-viable under normal culture conditions but which can become viable again under different circumstances. Aggregation of organisms can lead to major errors since they may be counted as single colonies. It will not be enough to detect just a particular kind of pure organism because there will often be the natural form of a recombinant organism present in the air. Methods of determining the very small genetic differences between the two and applying these in practical situations are as yet undeveloped. In the future it will be important to understand how complex air flows in real working environments distort the patterns of distribution and for this our collaborators are developing an understanding of how the mechanics of air flow affects the outcome.

Lord Flowers raised the question of who should fund the necessary fundamental studies of these generic issues of biosafety. As with deliberate release where a larger number of public funded studies are in progress in Europe, the basic issues must be funded by government.

Industry is concerned with the production of specific products from which generic conclusions are often difficult to draw. It is noticable that the large funds from the pharmaceutical industry are given for basic molecular biology and other biological research. For example, Squibb and Monsanto have made very large investments in Oxford University as has Eisai at UCL. This because the biology leads ultimately to patented products which are the present basis of profitability.

Industry is less inclined to support fundamental engineering studies because process patents are hard to sustain and therefore the knowledge is more freely available. Furthermore, process companies rarely do much basic engineering research. Process engineering is traditionally brought in at the development stage and company engineering departments rarely have budgets for university research. Biochemical engineering studies must be funded by company research scientists out of budgets focused on science. The fact that biochemical engineering is a very young discipline also means that most senior process engineers in the UK are still chemical engineers so that their inclinations are not biological.

Against this background (and the same is true in the USA, see enclosure) the SERC has recognised that the creation of the necessary biochemical engineering foundation is essential in order that the UK's strength in biology is not wasted by a lack of process research and especially of trained people able to scale up the biology into safe and efficient processes.

Whatever the outcome of the White Paper it is essential that the integration of bioscience and biochemical engineering, fostered by the Biotechnology Directorate, is not lost.

Peter Dunnill

11 *May* 1993

PUTTING BIOTECHNOLOGY TO WORK: BIOPROCESS ENGINEERING

National Academy of Sciences, Washington, DC 1992

RECOMMENDATIONS

To meet the global challenges of competition in industrialization of biotechnology and to address national needs, the Committee recommends the initiation of:

- A coordinated, long-term plan of research, development, training and education in bioprocess engineering, with well-defined goals that involve participation of industry, academe, and the Federal government.
- A research and educational program in bioprocess engineering that emphasizes cross-disciplinary interactions between scientists and engineers and a multi-disciplinary team approach to problem-solving, which has historically been the keystone of success in American industrial development.

The ability of the United States to sustain a dominant global position in biotechnology lies in developing a strong resource base for bioprocess engineering and bioproduct manufacturing and maintaining its primacy in basic life-science research. The United States has made an enormous, and enormously successful, investment in basic biological science. To protect the investment and to capitalize on it, there must now also be an investment in bioprocess engineering.

Letter and Memorandum from the Edinburgh Centre for Rural Research

I refer to your letter of the 17 May, calling for evidence to place before your Select Committee.

I have pleasure in enclosing evidence from the Edinburgh Centre for Rural Research, a "facilitating body" catering for the needs of some 18 independent research organisations situated in and around the Edinburgh area.

Since this body may not be known to your Members, I enclose a brochure *(not printed)* which sets out our aims and objectives and membership. Further copies of this brochure can be made available upon request.

There is a much greater sense of "co-operation" in R & D in Scotland, partly due to its relatively small size but also in part due to the fact that R & D, teaching and advisory work have always been kept in close harmony north of the border, whereas in the south these three related functions have been kept separate and under different management. This co-operation, which is spoken of locally as the "Scottish System", is worthy of some brief study by your sub-committee and it is for this reason that I have been asked to cordially invite your members to visit us during your proposed visit to Scotland this late summer/early autumn.

If we can be of any service to your members in this way, please let me know and I will be pleased to set up the necessary arrangements.

Peter N Wilson
Scientific Director

28 *June* 1993

I believe it is important to concentrate on a few of the 12 questions posed which are of particular interest in the Scottish context. If the Committee come to Scotland it is important that they hear something a little different from the presentations made south of the border. It is also important that the members of the Select Committee learn something of the "Scottish System" which is perhaps better known and understood abroad than it is in England.

The following numbers refer to the numbered questions posed by the Select Committee:

3. The connections are loose and tenuous. However, a much greater degree of cohesion and common purpose is planned as a result of the recent OST White Paper, which in a sense has overtaken the framing of the Select Committee's list of questions.

In Scotland, the smaller size of the R & D field, and the fact that many Institutes are grouped conveniently near to one another (such as at Edinburgh, Glasgow and Aberdeen) means that interactions are more frequent and also that most workers in related R & D fields know each other, their programmes and facilities and research portfolios, very well. In the agricultural field, in particular, the same government funding department (SOAFD) is responsible for both R & D (at the five SARIs and at SAC) and also technology transfer (through the advisory services run by SAC). The close relationship of Research, Education and Advisory work (all conducted by the unified SAC) also aids technology transfer in that the teachers of the next generation of professional agriculturalists are the same people, or are colleagues within the same organisation, as those undertaking research and extension activities.

This close integration of the different functions also takes place in other disciplines but is perhaps most clearly illustrated in the case of agricultural science and technology.

A major missing link, particularly from the UK position, is knowledge of the R & D conducted in the other EC States. This is partly due to the fact that there is a natural competitiveness between countries (each is involved in its own nation's wealth creation) but even more so because communications between the island of GB and the rest of Europe are more expensive and remote. It may be as quick to travel from the UK to another European capital as from one continental capital to another but it is infinitely more expensive. In spite of an increasing amount of EC-funded co-operative R & D projects Heads of Institutions are still reluctant to sanction travel costs outwith the UK unless they can be recouped or unless they are likely to result in EC contracts. This places a major constraint on "bench scientists" especially young and relatively unestablished scientists.

6. It is doubtful whether the HEFCs themselves have "objectives and priorities" other than the encouragement of the pursuit of excellence. It must be remembered that most University research is now funded from outwith HEFC grants which provide the infrastructure and main capital resource base but which do not provide the bulk of the recurrent expenditure on which R & D largely depends. The priorities are therefore mainly set by the grant-awarding bodies—research councils, charitable institutions or commercial companies. All strong University research teams are very much dependent on these external sources of funding and it follows that successful funding of University research is dependent upon applying for, and winning, research contracts which fall within the aims and priorities of these outside bodies.

It is an interesting debating point whether such dependence on outside funding is good or bad. On the one hand, it ensures that University research is more relevant to the perceived needs of these other national institutions, both public and private. On the other hand it could be argued that this dependence results in a certain loss of academic freedom and the ability of good research workers to "follow their own nose" whether or not their programmes are attractive to others. In theory a happy blend of "free funding" and "contract funding" is probably desirable and in theory this blend currently exists. However, as time goes on it is a fact that a greater degree of external pressure on research policies and programmes is inevitable as the ratio of funding from the two sources changes progressively in favour of the prescribed external contract.

7. This distribution of the block grant is changing fairly dramatically at the present time as a result of the 1992 Research Selectivity Exercise. In theory, the Universities could ignore the results of this exercise as once they have secured their "new" block grant they are free to distribute this as they think fit. However, the ways in which the block grant is spent will in future be closely monitored, and it is likely that fiscal penalties, such

as by clawbacks, will result if the Universities do not reward "departments of excellence" and continue to distribute the monies widely and thinly. It must be said, however, that resort to a form of "automatic formula funding" based on the Research Selectivity ratings will not allow new areas of research to be initiated either from scratch or from a modest base, and it is to be hoped that the Universities will continue to exercise their own value judgments in order to stimulate work in new and relevant areas even if this means that highly rated departments are to some degree "top sliced" as a consequence. If this is not done, new appointments to previously lowly rated departments will find it impossible to generate new and exciting avenues of research.

8(d). This question is already dealt with, in part, in answer to Q7 above.

General

The OST White Paper raises many of the issues touched upon in the 12 questions posed by the Select Committee. It seeks to give the direction of research a more clearly defined goal, in terms of targeting research to enhance the UK Science Base, to assist in wealth creation and to improve the "quality of life". These are admirable aims and it is hoped that the re-grouping of the new six Research Councils, and the setting up of a Director Generalship of Research Councils within the OST, will achieve this new mission.

However, it is perhaps debatable how realistic a prospect the privatisation of "a number of research establishments" may be especially in the agricultural sector, as many of them serve an "industry" which is difficult to define in the normal commercial and industrial terms. This is perhaps most pertinent to the new "Bio-technology and Biological Science Council" group of Research Institutes which are likely to have great difficulty in finding non-governmental funding from the "biological (agricultural) industry". This industry is diffuse, sub-divided and composed of a large number of very small businesses (such as farms) and which consequently would have great difficulty in fund-raising other than through the means of a statutory levy. Former levies of this nature (such as those administered by the Marketing Boards for Milk and Potatoes) are now under threat. Since Scotland has a large proportion of its land, and its population, engaged in such "industries" this point has great relevance and significance in the Scottish context.

Memorandum by the Department of the Environment

1. The Sub-Committee has invited written submissions on a number of questions. This memorandum briefly sets out the Department's responses where relevant.

2. *Expenditure*. The Department of the Environment spent £89 million on research in 1992-93 of which £13 million was spent in the science base including HEIs and Research Council institutes. This does not include research sponsored by bodies receiving grants-in-aid from DOE (eg National Rivers Authority, English Nature).

3. *Objectives and Priorities*. The Department's generic mission statement for funding research is given in the recent White Paper "Realising our Potential". Its most recent statement of objectives is given in the 1992 Annual Report.

Inform current Ministerial decisions;

Guide the execution of policy;

Monitor the achievement of environmental goals;

Address issues on which Ministers may need to take decisions in the future;

Sponsor collaborative research to underpin construction and pollution abatement technologies where the work would not have been undertaken by industry alone.

Its research priorities are published annually as the DOE Research Market, and details are published in research newsletters to the relevant contracting communities.

4. In commissioning work the Department generally does not distinguish between basic, strategic and applied research. The rationale and objectives of research to meet policy objectives in each key policy area is reviewed within a five-year rolling programme. These assessments are generally made publicly available including to contractors. Accordingly programmes and prospects are of short or long-term duration according to the problem involved.

5. The Department generally places its work under competitive tender, in accordance with the principles laid out in the White Paper. Work is therefore placed in universities, Research Council institutes, Government research establishments and private sector research contractors. A limited amount of work is placed with overseas or international research contractors. This proportion may be expected to increase as the EC Procurement Directive makes our research requirements more widely known in the Community. However much of the research commissioned by the Department is intrinsically UK in its scope.

6. A primary requirement of DOE, as with any other purchasers of research services, from the Science Base is trained manpower. Without trained manpower it would be impossible to commission UK research that would be good value for money. The strength and quality of the UK Science Base is an important advantage to the UK in many of its international negotiations. A secondary but important benefit from a strong science base is a general deepening of our knowledge in areas of science relevant to the Department's responsibilities. Both these elements are embodied in the new Research Council missions.

7. Under current arrangements DOE officials take an active role in Research Council priority formulation both at Council and science committee level. Our aim is to ensure that research councils are fully informed on likely trends in DOE research interests when making their priority decisions. DOE welcomes the opportunity to draw up concordats with the new Research Councils, and looks forward to consultations with the Director General of Research Councils on the mechanisms to be devised to ensure that user communities are able to play a full part in the new processes to develop the strategy for the Science Budget.

8. The European Community part funds research in areas related to DOE interests and those of relevant Research Councils. Estimates suggest EC programmes return c £10 million per annum to the UK science community in the environment and climatology area alone. An issue of increasing importance as the EC Framework Programme IV approaches, is the setting of priorities in relevant EC research programmes. The proposed expenditure is much higher than that under the current Framework Programme III. The White Paper describes principles the Government will apply in developing its UK position on Framework Programme IV. At the present stage in the negotiations, it is difficult to judge the scale of programme for which DOE could be properly attributed. However the attribution could be on a scale that might significantly affect our ability to fund directly, UK research. DOE is looking closely at how better value for money can be achieved for the programmes for which the Department could be attributed.

Memorandum from Glaxo Holdings plc

INTRODUCTION

We welcome this enquiry by the Select Committee into the setting and implementation of priorities for the Science Base. We believe this enquiry to be particularly timely as it seeks to address issues raised in the recently published White Paper "Realising Our Potential".

In this submission we have used the definition of the "Science Base" provided in the "Call for Evidence" invitation. Thus the term will refer herein to science and technology within the universities and public research institutes. However we would stress that the UK science base should be seen as extending to encompass science and technology within the industrial and government science sectors. We believe that it is important that all of these sectors should see themselves as components of, and partners within, the UK science base.

Glaxo is a company which is exclusively devoted to the discovery, development, manufacturing and marketing of prescription medicines for important human diseases. This means that we are critically dependent upon innovative science in order to understand human disease processes in order to identify targets for drug intervention. We are also dependent upon a range of scientific and technological activities for the development phase of a new medicine in order to improve and scale up chemical processes for manufacture, for the development of better ways of formulating drugs for effective delivery to the site of the disease, and for improving the efficiency of the safety and efficacy evaluation of new medicines.

Glaxo employs over 7,000 people in its world-wide R&D facilities and in 1992–93 has spent about £740 million on drug discovery and development activities. In addition, we have developed many collaborative arrangements with the Science Base in universities and research institutes and strategic alliances with biotechnology-based companies in the UK, Europe, USA and elsewhere. We regard these collaborations as important because they provide for interactions between industrial and academic scientists, they have the potential to allow for the rapid application of new technologies and exploitation of new knowledge. Glaxo at present has collaborative projects or programmes in 37 UK academic institutions and devotes approximately £5 million to these per year. In addition we also enter into major collaborations with academia such as that made possible, by the creation 18 months ago, of the Glaxo Institute of Applied Pharmacology at Cambridge and our recently launched multicentre and multidisciplinary initiative—*"Action tb"*—in the field of Tuberculosis research.

Being a company in a highly science-dependent industry Glaxo is also dependent upon the public sector science base for the provision of well trained scientific and technical staff for our own laboratories. Again, we recognise the importance of scientific education and training by the provision of over 90 places within our science-based operations for undergraduate students to acquire experience of industrial science and technology whilst undertaking degree courses. We also provide support for about 250 research students, mainly involved in PhD courses, in over 50 UK universities and similar institutions. These all operate on CASE-principles and so provide the student with research experience in both academic and industrial environments. Increasingly we are providing training awareness for science students and graduates in other countries through local Glaxo companies.

In addition to support for students we also make contributions to university and college departments and schools by the donation of equipment. Teaching as well as research is supported by Glaxo through the endowment of professional chairs, lectureships, and college fellowships in UK universities.

1. *What is public expenditure on the Science Base for?*

We believe that public money should be used for three purposes to support the Science Base.

Firstly, it should be used to support the scientific and technological infrastructure of our academic institutions to allow them to carry out their scientific research to the highest possible standards and to be able to compete with similar institutions overseas. Over the last twenty years we have seen a steady decline in the infrastructure of university science departments—both in respect of buildings and also equipment. We believe it is the responsibility of Government to ensure an adequate infrastructure and it should not be left to industry or the charities to fill the void. Poor facilities inevitably lead to a decline in the standard of the science that can be practised. The days are long since past when the scientist could make do with string, sealing-wax and his ingenuity. Modern science demands access to sophisticated and expensive equipment such as powerful electron microscopes, NMR machines and imaging technology such as PET and MRI. Increasingly science is becoming dependent on access to the advances made in the field of computing and information technology.

Secondly, government funds are required to underpin the level of fundamental or "curiosity-driven" research that is essential for the development of the inquiring mind and for creative science. Thus university science and technology departments do require uncommitted funds which are available to young scientists for work that has no immediate project related justification. The decline in availability of seed-corn funds for academic departments is exacerbated by the unrealistically low level of financial support given for the laboratory activities of PhD students. We do not see it as the responsibility of industry to provide such funding on any large scale.

Thirdly public funds must be available to ensure that our young scientists are given the level of education and training which is demanded for the practice of science and technology in the last decade of the twentieth century and beyond. At undergraduate level, funding must be sufficient to ensure that, not only can a sound grasp of the theoretical aspects of the subject be given, but also an adequate level of practical skill is achieved. At postgraduate level funding is required not only to provide resources, as mentioned above, but also to ensure that the student stipends are sufficient to allow a reasonable standard of living. The provision of people with competence and skills in science and technology is of vital importance for academia, for government science and for industry. Failure to maintain standards of education and training will result in a drain of our best young scientists towards competitor nations and ultimately economic failure.

2. *What are the objectives and priorities of the various funding agencies within government?*

(a) The existing systems: Our experience has been with the SERC and MRC. It does not seem to us that either of these Councils had any policies or strategies in most areas of their field of responsibility. The exceptions we note are, in the case of SERC, their policy to focus support in the biotechnology field to declared objectives in the Biotransformations field, and, in the case of the MRC, the AIDS-directed programme. The LINK schemes are the clearest example of policy for the support of scientific research activities. This was regulated through the LINK steering committee and has achieved a significant degree of focus within the supported programmes.

With the publication of the White Paper on science and technology this question has been largely overtaken by events. The new structures outlined in the White Paper should, we believe, provide a greater degree of overview of the activities of the Science Base that the present structures have in the past. It is respectfully suggested that the Select Committee should examine how best the new structure could be employed to foster science and technology in the UK and to harness it for the future overall well-being of the nation. It is important, within the new structures, that due recognition is given to the need to achieve balance between so-called "curiosity" research and research more obviously directed towards specific objectives. However both need to be seen against a background of national priorities and provision made for them accordingly.

(b) Technology Foresight: The Technology Foresight Programme should play an important role in determining the future science and technology needs of the UK and the intention that the process should involve consultation with all sectors of the science community and the seeking of expert advice should be both welcomed and implemented. Where new technologies are identified they must be seen in the context of their potential utility to the UK and the impulse to jump on new technological bandwagons resisted. New developments which are clearly essential or important for UK industry or commerce must receive adequate financial support to ensure their successful exploitation. Although there is a good argument that the industrial and commercial sectors or organisations should provide funding where they have an interest in exploitation, it is also important that funding is provided by government through funding agencies, such as the Research Councils, or through Government departments. This will be particulalry true in the earlier stages of development. Thus the Technology Foresight Programme must be backed up with an intention to provide money. This will best be achieved by adoption of the results of Technology Foresight into the National Science and Technology policy, which we would expect to be clearly enunciated in the "Forward Look".

(c) The Research Councils: It is important, we believe, that research activities of the Science Base are encouraged into areas of national importance by the adoption of strategies, within the overall policy, which will set missions with clear objectives. The new Research Councils should be the main vehicle through which this is brought about. They will however need to take a different approach to project selection than did the old Councils, and they will also need to take account of priorities set within strategic objectives. This is not to suggest that research in academia must be forced into an applied research mould. In our context we would see "mission research" as covering the broad spectrum from basic research (eg the elucidation of the cellular and molecular basis of human disease to define targets for drug intervention), through the developing of new technology to allow new molecules to be discovered to address the target, to the applied research needed to convert the lead compound(s) identified into safe and useful medicines. We suggest that broadly similar models can be constructed to analyse R&D needs of other sectors of industry.

We would see the financial support for such "mission-orientated research" as being within the broad responsibility of the Research Councils, It must be recognised however that the fields of modern science and technology defy attempts at a rigid classification. Thus boundaries are difficult to draw with any degree of certainty or precision. The new funding agencies must recognise this, as must the Council for Science & Technology to be established under the White Paper. Thus we suggest that, although particular subject areas may need to be allocated to particular Research Council "pigeon holes" for convenience of administration, the boundaries drawn cannot be set in concrete. Furthermore the missions of the Research Councils must not be seen in broad terms, dictated by either their titles or areas of responsibility. This would produce little change over the situation which exists at present. Each Research Council must have a number of specific, strategically important, missions or programmes for which it holds prime responsibility. The new Director-General of Research Councils will need to play a crucial role, not only in relation to resource allocation within the national framework, but also in setting the missions and ensuring that, where they may cross Research Council boundaries, they are seen as an opportunity for partnership and not regarded as cause to assert territorial rights. The Director-General must play a vital and central role in the future workings of the Research Councils and also ensure that they are accountable for the mission responsibilities placed upon them. Thus it is vitally important that the right person is chosen for this new post.

(d) **The "Mission Model" for research:** We suggest that the "mission model" for the prosecution of strategically important research programmes provides an opportunity for the development of close partnerships between academia, industry, commerce and government: industry and commerce being involved in the decision process in setting missions and also in providing some of the funding. The model also provides the opportunity for focused and managed research programmes involving several partners across scientific disciplines and also across sectors of the science community. Glaxo has put these principles into practice with the recent creation of our "Action tb" initiative. This involves academic scientists from several university institutions as well as our own scientists; it has secure funding over a period of five years; and is aimed at understanding of the TB organism, and in particular its molecular genetics and biochemistry, and the response of the host to its presence. The programme is managed and all partners have a clear aim—the discovery and development of new ways of treating a serious and increasingly common disease.

Such a "Partnership in Mission" concept does however require changes in attitude on the part of the potential partners. Collaboration should be the norm rather than the isolated individual or specialist group, a long term vision is required and long term funding is called for. Results may be slow coming but the participants will be required to be receptive and prepared to utilise new information and new concepts for the programme, that arise from the efforts of their collaborators, and be prepared to change direction when this becomes necessary.

(e) **Postgraduate training:** Responsibility for post-graduate training has traditionally been the responsibility of the Research Councils through the award of PhD studentships and awards for training in research methods etc. However the role of both industry and charitable bodies in this context should be recognised. Under the new structure there is no reason to suggest that responsibility for the allocation of publicly-funded post-graduate awards should be changed. However it is suggested that the mechanism of funding and the level of personal support for research students should be critically examined through the Research Council structure.

We would suggest that the training of professional scientists should not end with the PhD and that the post-doctoral period should be regarded as continuing training. This would mirror the apprenticeship-type training which has been for long established in medicine and surgery. Thus the Research Councils would provide funding on a personal basis rather than linking it to a specific project, leaving the post-doctoral Fellow free to continue his training in a centre appropriate to his interests, to explore his own ideas and receive guidance from an experienced scientist. Such a scheme would provide for "curiosity-driven" research projects and could provide a good basis for scientific development of the individual. Thus we believe that the public funding agencies should have the provision of a trained scientific work-force as an objective.

3. *What are the relationships between government funding for the Science Base and funding from non-governmental or foreign sources?*

With the cut-backs in government funding for research in academia over recent years the universities and similar institutions have turned towards alternative sources of finance for their research activities. Whilst this has brought advantages to both sides, this development has led to the development of tensions between the institutions and industry.

On the face of it government funding of the Science Base and funding by industry seem to have no obvious relationship. However it is recognised that the general expenses of running the institutions are provided from central government funds, via the Higher Education Funding Councils and their predecessors. This situation gives rise to increasing concern on the part of university administrators to ensure that industrial collaborators made a contribution to the indirect costs ("overheads") of the project being sponsored. Until recently no such requirement has been placed on the Research Councils and charities in respect of the research projects they supported. More recently however the Councils have contributed towards the indirect costs of projects within their grants, but to allow them to do this money was transferred to them from the HEFCs' budgets. Thus the arrangement is something of a fiction, but it does have the effect of favouring those departments who are able to attract the project grants and removed what was seen as seed-corn research funding from departments less favoured by the grant approval system.

There is therefore, in reality, a double standard being operated with collaborative research being "surcharged" when the sponsor is industrial despite the fact that the work being supported is often virtually the same in nature. It is frequently the case that the academic turns to industry because he is unable to obtain government funding for his project. As far as this Company is concerned, we make a contribution to the university for the indirect costs incurred which amounts to 42 per cent of the total salary and consumable elements of the grant. We believe this to be a fair figure when we are engaging in collaborative research with public sector colleagues. However in recent years certain establishments have attempted to increase this percentage to levels we consider to be inappropriate in view of the nature of the relationship. Because of this it has proved impossible in some cases to reach agreement and the project has not gone ahead. This is one example of the tensions which have developed between certain academic institutions and industry which arise out of the present levels of funding by the government of academic science departments.

A second area of tension concerns ownership and exploitation of intellectual property rights (IPR) and provision of reward by way of Royalty payments. The present financially constrained environment has led the academic institutions to demand unrealistic IPR terms with little regard to the context of the project. Again this tendency has lead to support for research projects being rejected by industry. The policy of the previous administration to encourage universities to seek industrial funding for their infrastructure and activities, together with an inadequate level of central government funding, led to this situation developing. Attempts by universities to exploit their research have resulted in most of them developing Industrial Liaison, or Technology Transfer, departments whose objectives become fund-raising without understanding either the needs of the academic departments or the requirements of industry. Thus where success has been obtained in a particular field there is a tendency to believe that the same formula will always be applicable. Thus with some of these groups there is a tendency to operate blanket rules without regard to the differences between sectors of industry. Doctrinaire policies have been developed which have created barriers between the academic and industrial sectors.

Another problem arising out of the same financial imperatives, which is acutely seen in the biotechnology field, is the tendency for over-optimistic views of the commercial potential of the work of the academic groups. This leads to attempts to obtain patent protection in inappropriate circumstances and attempts to license out the technology. This has recently been most clearly seen in the human genome cases where attempts have been made to patent DNA sequences without knowing the functions of the genes they represent. The effect of this trend could well be to effectively "sterilise" areas of biotechnology and make exploitation difficult as far as industry is concerned.

The third danger which stems from the failure of public funding is the increasing tendency of academic institutions to see themselves as providers of services for industry as "contract houses". Carried too far this trend could result in a compromising of the nature of academic science activities and the stifling of creativity which the universities, in other contexts, see as detrimental. The academic groups often fail to understand that in many areas they are operating in a competitive environment, that expertise is rarely unique and that there are such things as market pressures.

These developments, carried too far, will create barriers between UK academic institutions and industry and will encourage industry to look to the science bases of other countries. They are a result of government's underfunding for the basic infrastructural needs of modern science-based institutions and this is a priority which must be addressed urgently when considering new policy and strategies for the Science Base. It must be recognised however that the financial resource available for the Science Base is not unlimited and that choices will have to be made. Further, the belief that every academic science department in the UK is worthy of support as a research institution needs to be challenged in this context. Thus it is not necessarily the case that the Science Base requires a greater investment from public funds; rather it may be suggested that better use of the funds currently available should first be considered.

There are a number of initiatives in existence which provide a direct link between government and industry in the funding of science and technology. The LINK scheme and the CASE-type awards are two examples of which Glaxo has some considerable experience. The CASE awards we believe provide a valuable means by which academic and industrial scientists can collaborate in both research and also training of young scientists. It provides an extra dimension to the PhD course by providing an opportunity for the academic supervisor and the student to come close to the industrial environment and to understand its particular emphasis and needs. It also provides the industrial supervisor with an opportunity to collaborate at the cutting edge of basic science with academia. We have based our own fully funded PhD studentship and research scholarship schemes on CASE principles and would hope that the new Research Councils and the Charities will be encouraged to adopt and build on this model.

In our experience of over 16 LINK collaborations the schemes have had rather varied outcomes. We believe that recent adjustments to the "rules" have harnessed the good features of the scheme and now allow smaller groupings of academic and industrial partners to be supported. These have more potential for success that the earlier "mega-programme" arrangements which made it more difficult to get a proper industrial involvement in the scientific activities of the programme and resulted in the industrial partners being little more than funding bodies. The LINK concept should be developed under the new arrangements to provide for effective partnership between the three legs of UK science—industry, government and academia.

This Company has not actively sought project funding through the EC schemes and so we can make no comments upon the relationship between the EC funding schemes and the Science Base. Some of these schemes are designed to support near-market research which is not appropriate for our industry.

It is therefore clear that there are a number of parties involved in the funding of the UK Science Base and although there are some relationships connecting them, these are the exception rather than the rule. The "pipers" having a number of paymasters has produced tensions which have been counter-productive in some respects. The White Paper encourages a spirit of partnership between the different paymasters and the "pipers" and provides a framework which encourages consultation and collaboration. We believe that it is essential that this framework is put into effect.

4. *What information and advice is needed for those setting priorities?*

This question is also to a large extent superseded by the publication of the White Paper which aims to create a fremework in which UK science and technology resources can be employed to enhance wealth creation. We believe that this overall objective embraces issues concerning the health and well being of individuals and the UK's industries which are the means of wealth creation. Essentially those making decisions regarding priorities for science and technology will need to be informed about what these needs are and this information should be sought from a number of different sources. These will include government departments, public services, and industry as well as experts in fields such as academic science and engineering, medicine and economics. The new structure for science makes provision for such advice to be obtained in the Technology Foresight Programme and also by the Council for Science and Technology. The Technology Foresight Programme, by creating foresight assessment panels made up of experts in important technology sectors, should ensure that tracking of technological developments in other countries is undertaken. This could then be followed by adding them to the UK's armamentarium of science and technology where this is appropriate. By using technology assessement panels in this way the White Paper envisages that collaborations between academia and industry will develop which in turn could bring about the application of new technology in a timely fashion to strategic objectives. We would support this concept and look forward to its implementation.

5. *How do charities and companies funding research set and implement priorities?*

We cannot speak about the policy decisions taken by the research-supporting charities except to express the hope that they will operate within the overall framework wherever possible and encourage inter-sector collaboration.

(a) **Setting priorities in Glaxo.** In the case of Glaxo our funding priorities for projects are based upon the same principle, whether undertaken within the company or in academic institutions. The projects must be directed towards achieving the discovery and development of novel medicines for the treatment of human diseases. Our research activities at present cover eight therapeutic areas which between them embrace most of the serious diseases for which treatment, or better treatment, is required. The in-house research is carried out in our laboratories in the UK, USA, Italy, France, Spain and Japan and responsibility for the management of the research programmes in each of the therapeutic areas is in the hands of a Research Management Committee (RMC). Each RMC is made up of those scientists leading the component projects within a programme and they are under the chairmanship of senior Glaxo scientists. The RMCs are responsible for evolving the research strategy to be pursued within their therapeutic areas and also for ensuring its implementation and monitoring. Oversight of the RMCs is undertaken by International Research Strategy Committees which approve strategies, allocate resources and review progress of the research.

(b) **Selection of external projects.** The decision-making process in respect of external projects and programmes which we fund is usually also undertaken by the RMCs and the projects chosen for support must be entirely complementary to our own projects and have prospect of adding value. In most instances the external project is selected because it can add new knowledge concerning molecular or cellular mechanisms underlying disease processes. Essentially therefore priorities are established on the basis of meeting the needs of our own strategic objectives within the programme's mission. There are some cases in which the decision to support a collaborative project is taken because that collaboration will introduce us to therapeutic areas which are new to us but which fit within our objectives, or allow us to enter an emerging field. A good example of the latter is the work being undertaken within the human genome area.

The external collaborators are most commonly chosen by those involved in the Glaxo research projects on the basis of personal knowledge of the work of the academic group, usually after a process of inquiry and discussion. Less commonly collaborations arise out of unsolicited project proposals, although these are always given our consideration. We find that success of the collaboration goes beyond the generation of results and invariably the collaboration process results in an increased understanding of the area of science involved and a real synergy between academic and industrial groups.

(c) **Multidisciplinary programmes.** In some exceptional situations we use our ability to fund external projects in order to establish multidisciplinary and inter-institutional research programmes which are specifically designed to achieve a more rapid increase in knowledge which we believe to be necessary to meet an emerging new therapeutic or medical problem. A good example of this is the *"Action tb"* initiative Glaxo recently launched to meet the growing threat posed by antibiotic-resistant forms of *Mycobacterium tuberculosis* using the methods of modern genetics and molecular biology to understand the mechanism of antibiotic resistance, and identifying targets for new antibiotics. At the same time the Programme seeks a better understanding of the immunology of TB so that new approaches to vaccines for protection of populations may be identified. Glaxo has committed external funding of over £10 million to this five-year programme of research which will be carried out within three UK centres of excellence and three complementary academic centres in South Africa as well as in our own laboratories.

6. SUMMARY AND CONCLUSIONS

(a) In Glaxo we believe that the support of good quality science, technology and engineering within the academic sector of the UK science is important to ensure the welfare and health of the Nation.

(b) Government funding must be made available to ensure that the infrastructure of academic science is brought up to, and maintained at, a level that allows science and technology to be pursued to international standards. The importance of the universities and research institutions as the providers of skilled and innovative personnel for the UK's science-based industries must be recognised.

(c) It must be accepted that the money available for support of science and technology in the public sector is not an unlimited resource and it is therefore essential that it is used wisely and to best effect. This can only be achieved if national policies for science are generated, priorities are set and strategic missions established to ensure their successful outcome. We believe that the recent White Paper "Realising our Potential" provides a framework within which this can be achieved.

(d) The restructured Research Councils must play a crucial role in realising strategies for science and technology. A significant percentage of their financial allocation should be devoted to support of mission-directed research. This can best be achieved by building partnerships with the government and private sectors of UK science. We see the new Director-General as a critical appointment and his role should be to ensure that the Research Councils serve the wider science base rather than driving it. Existing schemes such as LINK and CASE can provide the basis of inter-sector understanding and collaboration and should be built on.

(e) Mission-research should not be regarded as in any way hostile to or incompatible with basic or inquiry research. Mission research involves a spectrum of activities from basic research within the mission objectives through to its application and ultimately exploitation.

(f) It must be recognised that industry has a part to play in the support of UK science and technology, both in terms of intellectual contributions and also the provision of funds. Barriers that come between industry and academia, and which prevent openness and partnership, must be removed.

Memorandum from Miles D Houslay, Professor of Biochemistry, University of Glasgow

What are the objectives and priorities of HEFCs in funding research?

Academics are geared to following research ideas that most excite them in essentially a "blue skies" fashion. Hence new ideas arise. Usually this is why people stay in academia rather than industry, ie they do not wish to be directed. This is not to say they are unprofessional or lack the incentive for competition. Far from it, to survive one has to take an aggressive stance in attracting funding from various sources and marketing and publishing output.

Some Universities and Departments are beginning to realise that they cannot afford to have small uncoordinated units. Priorities are to achieve critical masses of scientists working independently but on cognate means. This allows both a physical and intellectual infrastructure to be created. This is different from IRCs which can be seen as dedicating too many resources to too few individuals on too restricted a topic. Rather, groupings should be encouraged which allow for adventitious collaborations to arise and wither as would seem appropriate.

How is each university's block grant distributed between departments?

In Glasgow, as with many HEFCs, over the past few years there has been a move to formula rather than historic funding. My perception is that most HEFCs have attempted to evaluate a Department's contribution to teaching and research and on a basis related to this have devised a formula on whose basis to fund departmental running "appropriately". The move to transfer research funds outwith HEFCs and the pressure for HEFCs to take on ever larger student numbers has allowed such formulae to (i) expose the "underfunding" of the research base in HEFCs and (ii) pressurise the block grant distribution to be directed towards "high teaching" departments as these are in the main the largest source of funding from the UFC. This has meant that research departments are critically dependent upon transferred funds to support technical and support staff and also for the 40 per cent overhead to be directed back to the research department.

The pressure to be accountable has created a burden on active research departments which is wholly unacceptable without adequate administrative support. In the main this has not been forthcoming, thus many departments are spending far too much effort in accounting, forecasting, justifying and fighting to survive. Whilst the general idea of accountability could be entertained as useful this must be done in a well-organised and professional arena with appropriate support.

It would seem that most Universities have not bitten the bullet that science is really more expensive than arts teaching not only (obviously) at the level of consumables and equipment but also in terms of manpower. There is a need for considerable support staff to run practical classes, to run central facilities and to underpin the practical efforts of academics at the bench. Most formulae are then "egalitarian" or have a slight science weighting. Few Universities have accepted the fact that some parts must bring in the teaching funds and others the research and that the distribution formulae will be very different but, in each case, driven by targets to ensure competitiveness for survival. Few HEFCs have made hard decisions to withdraw from areas and focus their efforts. In many instances they are still a hostage to history.

What are the impacts on priority-setting of abolition of binary divide.

Realisation that Universities must make strategic decisions to get funds to support their research work. However, this is compromised by a variety of factors which include an inertia in the system, getting used to a new set of rules and being overwhelmed by new accountability for finances.

Regionalisation of funding

SHEFC have made the decision to distribute resources to departments very differently in that the formula employed does not give such a large fraction to Grade 5 departments as seen with the English council.

At a parochial level we have found it extremely disturbing that the unit of resource for biochemistry has been set at a considerably lower level than biology as a whole, preclinical anatomy/physiology and pharmacology and even Italian! When research councils recognise that modern molecular and cell biology done in biochemistry departments is perhaps the most expensive bioscience subject this is a nonsense. Couple that to the fact that our subject helps underpin the workings of the major (billion pound) pharmaceutical industry and this does not bode well. I believe the whole question of resource allocation to biological and chemical science subjects requires investigation in the light of this process.

Shift of funding from HEFCs to Research Councils

Problems in interpreting the rules of indirect support transfer and phasing of grants has led to difficulties in "claiming" at appropriate levels. For example:

- Different research councils have applied different rulings and these have changed over the period. Grants run in 3-5 year cycles and a number of the '92 start grants were submitted and running before the indirect claim support was formalised. Even some of the October 1992 ones were affected. Some rescue work was done at the level of adding 40 per cent overhead but not at the indirect transfer of support.
- Departments have to sort out the distribution of support staff so as to be able to claim for indirect salary transfer. This can be complicated in departments where a large fraction of support comes from charities.
- Some universities have put targets on departments for indirect and related funding to be gained. This can cause problems if targets are based on unrealistic scenarios eg past histories biased by large equipment grants, ratio of income from ABRC/charity support. Many large research departments are reeling under the attack of all of this. More grants to be written, more cost analyses and fighting with HEFC admin for reasonable targets and transfer of funds.

Formula funding, research rating and moves to RTX model

Research ratings are very important to universities at the financial and psychological level. Many are involved in great post-mortems on the last exercise.

It was difficult on the last exercise to make strategic decisions as to whether to include all or opt out some researchers as the cost implications were unclear. I must admit that some simple criteria of research achievement such as "had to have published a paper" or "obtained a major grant" would be essential for inclusion. It seems a non-sense to include people who clearly never did any research.

Discussions of graduate schools on the boards. Many departments are moving towards changing teaching and admin loads to reflect the research achievements of staff.

Formula funding is now *de rigueur*. However it leaves a lot to be desired. In many instances a formula which approximates perceived income is used to define funding. However, these must be refined to address strategic issues in the sense that it has to be accepted that some parts of HEFCs do more teaching than others and that not all of the teaching income goes to those departments (and vice versa). In all sectors targets (different) should be set.

Are research council priorities skewed by existence of institutes, obligations to support "big science" etc.?

MRC commitment to EMBL (European Molecular Biology Laboratory) takes up considerable funds but has little impact directly on the UK science base. No integrated interactions. Clearly good research is done there but is it of strategic value to the UK economy interpreted in its loosest sense? I think not. The money would be better used in the UK science base direct. Only reason for keeping up payments would be political and then best out of a separate pocket for similar ventures.

How is the money being transferred from the UFC to the research councils being spent?

As a member of various ABRC grant panels I can say that for the MRC and AFRC, as well as the 40 per cent salary overhead, monies are being spent to support infrastructure in the form of underwriting salaries (transfer) of UFC funded support staff, eg technical, associated with specific project/programme grants.

My perception as HOD is that the SERC has not been so forthcoming in providing the associated support and there is an impression that some funds have been used to create extra project grants.

Memorandum from the Institute of Biology

The Institute is not a body which either puts anything into the science base or gets anything out of it, so it cannot address the main questions at the end of the Call for Evidence.

However, it has members in industry, charities, universities and government departments and wishes to submit the following comments.

Public expenditure on the science base is primarily to permit enquiry by free minds (who can tell what the spin-off will be?) and to respond to the Nation's needs. It is the balance between these two components that we need to address. The former has been eroded to a degree which endangers our ability to respond to the challenges that will be faced by future generations. For example, long-term research into environmental trends is under increasing pressure (some programmes have been stopped) yet this is the information we require to predict long-term changes. The future of our *long-term* Science Base must be addressed.

A significant portion of expenditure should be of an exploratory, or "blue sky" nature without regard for applicability or relevance.

At the moment, there is too great a reluctance for Research Councils to fund "blue sky" research because of its intrinsic uncertainty. Reviewing Committees tend therefore to err on the side of caution rather than on enterprise and initiative.

Current problems in the Science Base are less concerned with priorities than with the policy of short-termism.

The current situation of universities and research institutes all competing for funding from Government and non-Government sources whilst satisfying market demands, is not entirely efficient in a holistic sense. There is major expenditure of staff time and resources on formulating and negotiating research proposals, and in accounting for the expenditure following a successful award. This is normally substantially greater than for research contracts with industry.

The shift from binary funding of universities to direct funding by the Research Councils may limit the development of new research initiatives by all but large well-established research groups in a small number of universities. The gradual decline of quality research facilities from universities who are forced to a teaching only function will be harmful in attracting new students into research from these institutions.

A general impression held by many research workers is that much of the funding awarded by the Research Councils is directed by precedent on the basis of history and reputation of the worker, making it difficult for others to obtain funds for new initiatives.

There is a large gap between the relatively small-scale research of professionals in teaching, medicine or engineering and the fully-funded project of the scale of an MRC program grant or EEC co-operative grant. Funds should be aimed at filling this gap, to provide fully-funded short-term projects that can be linked to research training and eventual funding by program grants. This could form the basis for allocating program grants and stimulating interest in research.

The EEC can distort government funding since not only is effort "sucked-in" to EEC approved project areas, but usually the EEC fund only 50 per cent of the costs thus requiring matching UK funds for the balance. This ties down Government funds which are no longer available for priorities set by the UK. A heavy dependence on industry for funding must be avoided. The priorities of industry are primarily for short-term applied research with only limited support for fundamental in-depth research. Fundamental research must be supported and this is most appropriate through public funding.

Charities, with a more "hands-off" approach to long-term support for groups working in specific areas, are generally more successful than the short term support and rapidly changing objectives seen in industry.

They operate very efficiently, with minimum bureaucracy, by employing a combination of the "great and good" and expert advice. Their low overheads attest to what can be achieved. They are *not* deflected by considerations of what might be "politically correct".

Research funding should not be too dependent upon charity money, however. Charitable collections, especially for emotive subjects (children) or diseases, can also distort priorities. Central funding should take account of these potential distortions.

Research is often a mixture of fundamental work coupled with development of that work into applied areas. There is therefore nothing intrinsically wrong in multiple funding, indeed this is often synergistic.

It is vital that the continuum of fundamental and applied research is not artificially broken. Nor should R&D be thought of as a linear progression in one direction.

Memorandum by the Institute of Ecology and Resource Management

I am Professor of Agriculture and Rural Economy at the University of Edinburgh and head of the University's Institute of Ecology and Resource Management. The Institute is a Department of average size (33 full-time academic staff, plus postgraduate students, research fellows, technical staff and administrative support), with a research income of approximately £1.5m per annum mostly from Research Councils and other Government-associated organisations. Sponsorship directly from industry is small, despite continuing efforts on our part.

Our research programme majors in matters relating to carbon dioxide flux (global warming), the sustainable production of food, the provision of wood, the protection of the environment, and animal welfare.

My Department is heartened by some aspects of the recent Government White Paper on Science & Technology; notably the acceptance of the equal value of basic, strategic and applied research and the apparent desire of Government to re-recognise the value of applied research as a major linking mechanism to allow a positive interface between research and industry.

My perception of the movement of monies from the HEFC to my Department is that this is closely related to the Research Assessment Exercise. In its turn, the RAE rating is closely related to the ability of departments to obtain funds from Government-associated funding sources. A significant part of the research agenda is therefore set by Government through its steering of funding priorities. This trend will be strengthened with the new advisory structures proposed in the White Paper.

I do not perceive the HEFCs as having any priorities with regard to the funding of university research, perhaps due to the situation adumbrated above. However, it is important to note that funds from the HEFC are not of sufficient magnitude themselves to fund any research at my University department level. The HEFC grant helps to pay for staff and to provide a "well-found" laboratory but actually to do any research with staff in the laboratory requires further funding from some other sponsor. It should be noted also that the staffing base is being depleted both in quantity and quality due to funding cuts, and the laboratories are no longer "well-found". We are thus becoming progressively more dependent for both staffing and fixed-base funding upon sponsors who might expect normally to be involved primarily in the funding of recurrent expenditures.

It is difficult to predict now the consequences of the abolition of the binary divide. My own best guess is that with the need to absorb progressive "efficiency gains" year on year, the loss of funds will mean the deepening of the already irreconcilable conflict faced by my staff between "teaching" and "research". Edinburgh is a University of research excellence (first in Scotland, fourth in UK) but the maintenance of this position will be very difficult in the face of increasing undergraduate student numbers and a progressive diminution of resource. The outcomes, in my view, are straightforward: (a) reduced quality of research—presumably not acceptable; (b) reduced quantity of students—presumably not acceptable; (c) raised income from non-HEFC sources through the media of (i) top-up fees or (ii) non-Government-associated research sponsors. With special regard to (c)(ii), my analysis is first that our work in the understanding of carbon dioxide balance, animal welfare, sustainable forestry and agriculture, and the protection of the environment is germane to society's needs, and second that it is "unlikely" to be met from sources other than those which are Government-associated. The direct input of our work directed from the industry base continues to be disappointing because the agriculture, forestry and environmental industries are not comprised of large firms but of many small units which find it difficult to come together to form a critical mass capable of identifying research priorities and formulating research support policies. I see no resolution to this problem other than the imposition of a levy (common in many other countries) on primary industries for the support of applied research.

My major concern is the burden imposed upon the universities through the failure of the Government to see that research and education at university level cannot tolerate demands for increased output commensurate with increased input and yet maintain quality standards—either of student education or of research. The position would be eased somewhat by the provision of some money at departmental level funded from within the University system and used specifically to fund research (basic, strategic and applied) independently of either Government-associated or industry sponsors; both these latter being "policy-led" and therefore not conducive to strategic science which is innovative or applied science which is imaginative.

It is my view, therefore, that industry and wealth creation would benefit if monies were available from the HEFCs and/or the Research Councils directly targeted to university department level for the pursuit of research but not tied to specific research contract areas. Such monies would be used especially to fund young research workers and to provide seed-corn support for innovative work, neither of which receive adequate support through the existing system, nor through review of peer committees. Discretion in expenditure at university departmental level of some proportion of research monies is essential for the advancement of excellence at universities but changes over recent years in the amount and methodology of funding have removed entirely such discretionary funds.

Colin T Whittemore
Professor of Agriculture and Rural Economy

14 *June* 1993

Letter and memorandum from the Institution of Electrical Engineers

The Institution has considered its response to the questions raised by the Sub-Committee on the subject of "Priorities for the Science Base" and our formal submission is appended to this letter.

We believe that the topic which the Sub-Committee is addressing is of fundamental importance to the nation and our response is based on the same premise that underlay our previous submission to the Office of Science and Technology regarding the role of the Government in supporting science and technology. We believe that the Government needs to support the *total* innovation process from pure scientific research, through strategic development to product development, and that the engineering dimension which is the link between basic scientific knowledge and industrial prosperity is not adequately funded.

We believe that the objectives of public expenditure on science and engineering are:

- to advance knowledge
- to provide a supply of well qualified and highly motivated staff
- to support the UK's industrial prosperity.

These criteria are mutually interactive and of equal importance. In particular we believe that without a strong industrial base the UK will not be able to afford to support the other two objectives adequately. All three need to be fully reflected in the processes for the allocation of government funding.

We are concerned that the terminological shorthand "science base", used to denote the subject matter of this enquiry, has no agreed definition and has become ambiguous and confusing. The Sub-Committee has chosen to define it in a manner which limits the boundaries of the committee's enquiry, and has restricted its sense to cover only scientific and engineering research associated with the universities and Research Councils. The science base might be regarded as the sum of available natural knowledge, and includes the technical knowledge essential to wealth creating industry. The Institution believes that we need to consider the total innovation process, covering basic and strategic research, applied research and product development, and the knowledge base which underpins this. Moreover, we should speak of "science and engineering" rather than "science and technology" as it is the engineering dimension which forms the bridge between pure scientific knowledge and industrial prosperity.

These points are developed in more detail in the appended paper.

The Institution would be pleased to comment further if so requested: in the meantime we shall be following the proceedings of the Sub-Committee with great interest.

J C Williams
Secretary

9 *June* 1993

The Institution of Electrical Engineers welcomes the opportunity to offer evidence to the Sub-Committee in those areas where we feel that the special nature of the Institution, with its balanced membership from industry, universities and government service, makes its comments particularly useful.

The Institution has already made a submission to the Office of Science & Technology in response to questions raised by the Chancellor of the Duchy of Lancaster regarding the role of government in science and technology, and the responses to the Select Committee's questions are based on the same foundation as was that submission.

We are very pleased that the White Paper "Realising our potential—A Strategy for Science, Engineering and Technology" incorporates many of the ideas and changes of direction the Institution and similar bodies recommended.

Engineering—the neglected element in the innovation process

As a general observation, the Institution believes that the term "the Science Base" in not very clearly defined nor understood. It is used to cover a wide range of disciplines and topics, as diverse as astronomy, particle physics, information technology and computing, and materials science, as well as many aspects of engineering. It is therefore impossible to make overall comments which are relevant to all these aspects. Furthermore the Cabinet Office's published data on Government funded R & D aggregates expenditure aimed at totally different objectives: 44 per cent of 1992 expenditure was for defence, almost all for the design of specific defence products and systems, 24 per cent for the advancement of knowledge with no other specified objective, and only 8 per cent in support of industrial development. To include expenditure on these widely differing objectives in a single overall figure is misleading and gives great opportunity for statistics to be quoted which on careful examination do not support the claimed conclusions.

We note that the specific definition of the "science base" used by the Select Committee is "all scientific, technological and engineering research and post-graduate training, however funded, conducted at, or in close conjunction with, universities (old and new) and Research Council institutes." It is, of course, understandable that the Sub-Committee needs to set limits to its terms of reference, but the UK "science base" must comprise more than purely the research carried out at or with universities and Research Council institutes.

The science base might be regarded as encompassing the sum of available natural knowledge; it includes the technical knowledge essential to wealth creating industry. Furthermore we must recognise the international dimension of scientific knowledge and advancement. Scientific results are normally published on a world-wide basis, and industry from all parts of the world can exploit them.

The main emphasis of the Institution's submission to the OST is that support of industrial prosperity must be a prime objective of the Government's expenditure on the total innovation process, and that all parts of this process, which comprises research—pure, strategic, and applied—as well as product development must be adequately funded. Products are brought to the market place from a base of available knowledge and skills, and for successful innovation the base must contain all that is necessary for the programme.

There appears to be very little direct correlation between a nation's excellence in basic science and its industrial prosperity—comparison of the performance of Japan and the UK is an obvious example. A fundamental reason is that the results of scientific work are normally published widely. Indeed any industrial organisation seeking world-wide markets must comb the world for the basic scientific work to support innovation; a UK-based company might enjoy some advantages if the basic science were available from the UK, but this would not compensate if more advanced work were taking place in another country.

A strong base of relevant scientific work is a clear advantage both in its own right, and to provide a stimulating environment to train the best people but it cannot alone ensure industrial prosperity, and must not be expected to do so.

Elements of basic science research represent just one item in the blend of engineering principles and practice which must be developed to facilitate the transfer of ideas to the finished product or service in the marketplace. The innovation process is iterative and cross functional, and the stages which follow the basic science research activity may well be more complex and demanding than the initial research stage. These subsequent stages are often not adequately managed in Britain, nor supported by engineering research and development projects or well-funded national infrastructure. The strong traditional support given to pure science research is not matched by appropriate and necessary support for the subsequent phases of the innovation process. If these infrastructure support elements were provided as part of a coherent Government industrial strategy then Britain would be in a strong position to make effective use of other nations' published science research as the Japanese have done so effectively. Both Germany and Japan have clearly constructed infrastructures to support the total innovation process and in particular the application of knowledge through product development and process engineering.

It is the engineering dimension which is the bridge between pure science and practical application for the creation of wealth, and we should stop using the terminology "Science and Technology" and replace it by "Science and Engineering", which gives a more appropriate emphasis to the engineering element.

RESPONSE TO THE SPECIFIC QUESTIONS RAISED BY THE SELECT COMMITTEE

1. *What is public expenditure on the Science Base for?*

The Institution identifies three main objectives of public expenditure on the "science base", and on what we have termed the "innovation process". These objectives are not in order of importance, and are mutually interactive.

(a) The advancement of knowledge

The scope of scientific knowledge in this context must embrace pure science and engineering, and include the important aspects relating to manufacturing technologies and processes.

Clearly an advanced country like the UK can be expected to make a major contribution to the world-wide efforts in this field, and for reasons of national prestige as well as providing a stimulating research environment to support (b), this must be one major objective of the expenditure.

(b) To provide a supply of well qualified and highly motivated technical staff

Industry as well as universities requires well qualified and competent people. There should be a national environment and infrastructure which encourages the most able people to undertake the most challenging projects. However these should not only be in the fields of basic and strategic science, but should involve much more applied work than is the case at present. This specific objective will have a high priority for HEIs.

(c) To support the UK's industrial prosperity

For the Government this objective perhaps should have the highest priority of the three, for without a restoration of the UK's economic prosperity based on industrial growth there may well be insufficient funds available from industry, as well as from Government, to support the necessary level of national expenditure on research and development.

It is essential that these three objectives be clearly specified, and that defined proportions of the available funds should be allocated to each. Even at "project" level, the objective of the project should be stated to be wholly or partially in one or more of these categories at the outset.

2. *What are the objectives and priorities of the various funding agencies within Government?*

The current objectives of the various government funding agencies are not sufficiently clearly defined. Various bodies have produced "Mission Statements" but in general these are not sufficiently clear. The Institution believes that the three objectives outlined in response to 1. above should be adopted by all these bodies. We are very pleased that the White Paper includes much clearer objectives and that the mission statement of the new Engineering and Physical Sciences Research Council (EPSRC) in particular specifically includes "applied" research to enhance the UK's industrial competitiveness.

In addition to clarifying the objectives and priorities of government funded research, it is also important to improve the structure of management of the research to ensure that the appropriate goals are established and achieved.

The way in which all Government bodies can be aligned to support the innovation process should be examined to make it easier for industry, particularly medium sized companies, to make full use of them for programmes aimed at specific new product and process development opportunities. The national industrial strategy should aim at supporting broad new product application areas, and we welcome the proposed Technology Foresight Programme to this end.

The aim of supporting industrial prosperity needs to be given increased emphasis and in this context the strategy of the SERC (the Research Council with which the IEE is most closely aligned) to support only "basic" and "strategic" research has in the past caused many problems in University Engineering departments. HEIs can make a valuable contribution to "strategic" research in industrially related topics, though under SERC criteria for assessment of projects, proposals must be carefully structured to avoid any element of "applicability" if they are to seek SERC support. This has been unfortunate and we are delighted that the White Paper specifically includes "applied" as well as "strategic" and "basic" research within the mission statement of the new EPSRC.

A clearer division of responsibility between the DTI and SERC appears to be essential, whereby the principal role of DTI is to administer funds in the support of industrial prosperity and that of the SERC is to support HEIs in the extension of knowledge. In each case funds would be available both to universities and to industry.

The LINK scheme for the support of joint industrial and university projects is sound in its general concept. The funding mechanism, however, needs to be re-examined, as the Treasury insists on regarding university or government department activities as part of the 50 per cent government support to industry, so that the funding to industry decreases as HEI participation increases. This can deter industrial collaboration. We are optimistic that the new focus for LINK within the OST will help to resolve many of these problems.

Although the peer review process may be the best available for scientific projects in pursuit of the extension of knowledge, it clearly is less so for projects which have some long-term economic benefit. In particular the assessment of projects by committees which comprise people whose departments could indirectly benefit in the longer term from strategic decisions made at the committee may produce conflicts of interest which are undesirable. The peer review process could be enhanced by greater industrial involvement.

3. *What are the relationships connecting the various sources of funding?*

The links between the various sources of funding are not strong, and the situation should be improved. It is very difficult for industrial companies to understand and manage their interaction with the many interfaces with government and universities. Help is required, particularly for medium sized companies. Also natural collaborative relationships such as large company—small supplier—materials developer should be exploited in collaborative schemes, not the unnatural relationships between competitor companies in pre-competitive programmes as is often the case at present.

Funding by industry is usually with a particular department of a single HEI where a recognised cell of expertise exists, large enough to have the critical mass required to achieve results in the relatively short timescales demanded by the industrial environment. Results of the work would normally be available only to the funding company. This consideration may often be a key factor in deciding whether the work can be industrially sponsored or not; the conflicting interests of academics who wish (and need, for career reasons) to publish results widely, and of industry which needs to confine access to the results to those providing the funds, are very difficult to resolve.

EC and other international funding may be valuable in some circumstances, but has its own problems. Clearly the long-term commitment of UK funds to major international collaborative projects can cause problems in later years, particularly if the rates of exchange in the currencies used change. The problem of international commitments becomes critical when the funds come from a defined budget of which they are a high fraction. This is exemplified by the situation of CERN and SERC where a change in the exchange rate may lead to cancellation of SERC UK projects in fields which are totally unrelated to particle physics. Proposals in the White Paper should considerably ameliorate this problem.

In the case of most EC schemes, funding is available only for collaborative projects involving partners from more than one EC country. This makes for an expensive administrative structure and also makes the changes of direction which are often necessary in highly technical projects much more difficult to achieve. These problems indicate that only major projects too large to be funded by a single nation or those projects where the exploitation of results demand international relationships should be pursued on an international collaborative basis.

4. *What information and advice is needed by those who are setting priorities?*

The White Paper's proposals for technology foresight, the forward look, and the new Council for Science and Technology are a more realistic approach than we have seen hitherto. It would appear that there is an opportunity for increased advice from bodies like the Royal Society and the Royal Academy of Engineering, and in the more applied areas the Professional Institutions (like the IEE) could often provide a uniquely balanced overview of the whole of the innovation process from basic concepts to product introduction.

5. *How do companies which fund research set and implement priorities? How is it done overseas? Are there lessons here for the Government?*

Companies normally have clearly defined objectives of their R & D programmes. At the level nearest the market, R & D involves the design of products with specified performance, cost and timescale parameters, which are necessary for the ongoing business. Within the company such projects are normally very clearly defined and controlled to ensure that the product is available at the right time and price for the market. In high technology areas, there are often many aspects of the technology which are not clearly understood, and where basic or strategic research may also be required. Accordingly companies will often fund this work internally, in areas where there is a consensus regarding future applicability in the company's fields of activity. If a university department has an adequate base of people and experience, the company may well fund such work there. However a major problem often exists in finding a group with the people, equipment and experience to form the "critical mass" necessary to make a real contribution in the required timescale.

The best practice companies merit study to answer the question and that in paragraph 4 above. In general they set priorities following market analysis, by establishing and fine tuning core competences and operating simultaneous engineering product introduction processes.

The principal lesson for Government would appear to be a clear statement of overall objectives which would include a national industrial policy. On this basis the Government should define its strategic and technological policy objectives in relation to the development of the science base. "Science base" research programmes should be driven by these policy objectives, and progress and benefits derived from the programmes should be reviewed. In establishing priorities due account must be taken of the results of research done both at home and overseas.

Universities Questions 6-8

Although the Institution could attempt to respond to the questions relating to universities we feel that a more comprehensive response will be provided by the universities directly.

9. *The Research Councils have explicit missions. How are these translated into priorities, by whom and on what basis?*

Although the SERC (for example) had a mission statement, the wording was rather general and could not really be described as "explicit". Translating this into a strategy or corporate plan is achieved by forming a consensus view by the Council members, and it does appear that there is a real need for some direction or guidance to be provided from outside the Councils in this respect. The White Paper is a very strong basis for a move in this direction.

The Councils need to have clearly defined roles and inter-relationships with other bodies in the innovation process.

In summary, the IEE has commented only on those questions where it feels it has a particular contribution. We have not commented on the Universities section, nor on questions regarding the conflicting priorities of the Research Councils.

Memorandum from the Institution of Professionals, Managers & Specialists (IPMS)

INTRODUCTION

1. The Institution of Professionals, Managers & Specialists (IPMS) is the trade union representing 90,000 scientific, technical and specialist staff in the Civil Service, related public organisations and an increasing number of private sector companies.

2. Annex 1 sets out the publicly funded establishments in which basic and strategic R&D forms part and in many cases a very substantial part of our members' work. Those in the research councils, AFRC, NERC and SERC and the Scottish Agricultural Research Institutes and Scottish Agricultural Colleges would fall clearly within the Committee's definition of the "Science Base". Others such as the Royal Botanic Gardens at Kew, and the scientists in the Natural History Museum are engaged in similar work. Others such as the government research establishments (GREs) are in a grey area but do perform substantial amounts of basic and strategic research especially since they were enjoined in 1987 to retreat from the "near market"—a policy which we are pleased to see the Science White Paper has modified if not reversed. This grey area is likely to increase as the White Paper policies of an open market for research and the further separation of the roles of "purchaser" and "provider" of research develop. Our evidence will therefore relate to all these areas as appropriate, although the centre of gravity will inevitably rest on the research councils and associated bodies. We have no members in the universities and therefore we will not be addressing the questions specifically related to them.

Q.1. *What is public expenditure on the science base for?*

3. Public funding of basic and strategic science aims to advance knowledge and to train scientists, technologists and engineers (STEs) at postgraduate level; to increase national prosperity and improve the quality of life; including support for "public goods" such as protection of the environment, health and safety at work, energy conservation, quality of food and medicines, security and defence.

4. Forms of strategic/basic research which need very long term and uninterrupted public support are the science databases for specific problem solving projects by others. Examples include germplasm banks and culture collections, the systematic biology database maintained by the Natural History Museum, and the National Geoscience Data Centre of the British Geological Survey (NERC). Such work needs to be properly funded and by its very nature should not be subject to short term switches of contract or to privatisation.

5. Public expenditure on the science base should also be primarily for scientific activity. There is a serious danger that with the increasing use of contracts, the rigid separation of "purchaser" and "provider" and the acceleration towards an "open market for research", too much time will be spent on transactional administration costs and too little on research.

Q.2. *What are the objectives and priorities of the various funding agencies within Government?—Research Councils, HEFCs, other departments. Are they related? Is an overview required, and do existing structures (ABRC, ACOST, OST) provide it?*

6. The roles of funding agencies within government are different and fairly clear, with the HEFC supporting research and teaching, and the research councils supporting basic and strategic research with their areas of interest and user groups potentially further clarified in the White Paper's embryonic mission

statements (although see Question 11). The role of government departments is less clear, however, a significant matter since they currently provide 60 per cent of total government R&D spending.

7. The White Paper simply says:

> "Other Government departments encourage and fund science and technology in support of department policy, statutory, operational, regulatory and procurement responsibilities. Wherever possible they involve and cooperate with others in meeting to align their own policy objectives with the general objectives of using publicly-funded science and technology programmes to increase national prosperity and improve the quality of life." (p. 10)

8. IPMS is concerned that the severe short term pressures on departmental spending will result in R&D being badly squeezed. Indeed, within the overall government spending on R&D, spending by civil departments has seen the most significant decline—30.3 per cent between 1982–83 and 1991–92. The two departments with the most significant cuts in spending were MAFF where spending dropped in real terms from £177.8 million in 1982–83 to £118.6 million in 1991–92 and DTI where the reduction was from £443.3 million to £309.5 million (1990–91 prices). DTI R&D expenditure is planned to continue declining—to £117.2 million in 1994–95. Recent actions of the President of the Board of Trade especially on the switch of funds away from supporting research projects towards support for innovation and technology transfer mechanisms and the decision to close the Warren Spring Laboratory which carries out major research on the environment and energy increase this concern.

9. The behaviour of departments in funding basic research is a far cry from the original Rothschild principle which the White Paper claims to be supporting and developing. Under the original Rothschild principles set out in the Framework for Government Research and Development (Cmnd 5046 HMSO June 1972) finance was transferred from research council grants to the "customer" departments eg MAFF for AFRC, with the intention that customers should sustain the research base in their charge. It said

> "Customer Departments have a responsibility to sustain, as a safeguard for the future, an adequate research capability in their area of concern; this does not mean that they have a duty to retain the capability of every contractor. But it does place on them a special responsibility in relation to certain contractors whose expertise is outstanding or unique or who occupy a central place in the country's scientific activities, such as Research Councils. For these contractors some certainty of funding is essential. In each case Departments are now endeavouring to provide an orderly succession of commissions, with the financial support planned well in advance, and, when changes in commissioning are inevitable, to give reasonable notice to the contractor."
>
> (Framework for Government Research op cit para 16.)

This responsibility has not been fully honoured and is less likely to be so in the future.

10. Rothschild also accepted that "customer" departments would need to ensure that to be able to sustain their general research capability the "contractors" eg the research councils, should receive some finance, not immediately related to a specific programme of work, via a surcharge (10 per cent was suggested as appropriate) on the customer's programmes. This promise too has not been honoured in many departments and certainly not to the level of 10 per cent. But there is no reference in the White Paper to the need for the Rothschild 10 per cent or some similar mechanism for supporting long term research.

11. Instead the White Paper prescribes an acceleration of market testing, a fully open market for R&D, and the privatisation of government funded research establishments. With all government agencies and research institutions now being judged against short-term targets there is a serious danger that the possibility of investing in projects with good pay back potential will divert attention away from basic strategic long term research. The nearest the White Paper comes to addressing longer term strategy in this context is to say that all departments should have effective procedures for reviewing their requirements for S&T, and their delivery. Also, in the case of research councils, the White Paper mentions the possibilities of "concordats"* such as those between the DH and MRC.

12. It is essential that clearer mechanisms and obligations should be introduced to ensure that departments play their full role in funding strategic and basic research relevant to their responsibilities. In this respect the Government's response to the House of Lords report on Forensic Science is hardly encouraging. For, while recognising that research should continue as a vital part of the proper development of forensic science the Home Office give no indication that they are prepared to pay for it. As the Select Committee itself says—

> "3. We draw particular attention to only one aspect of the response, namely the unwillingness of the Home Office to provide central support for R&D in forensic science, either through a small grant-making fund or by establishing and funding a university-based research centre. We agree with them that "there is no evidence that the Forensic Science Service commitment to research has been reduced by its move to agency status"; but we do not share their confidence that this will continue to be the case as the expanding market in forensic science services becomes more competitive."
>
> (6th Report of HofL Select Committee on the Government Response to the 5th Report: HL24-III p3).

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* Note: "a Concordat articulates their (department/research council) expectations and obligations and provides a framework for the systematic development, review and evaluation of their respective needs, priorities, activities and progress" (3.40).

Role of OST

13. Under the White Paper the OST has been given the responsibility of co-ordinating the government research effort but in reality it has been given very little control over what departments do. OST is directly responsible for only 20 per cent of Government R&D spending. DfE controls much of the expenditure in higher education through the Funding Councils and individual government departments control the rest.

14. In the White Paper the role of OST has been restricted to the development of long term strategy through the preparation of the Forward Look. It has been excluded from detailed discussions with individual departments. In preparing the Forward Look "The Office will seek contributions from Government Departments through the official Committee on Science and Technology..... The document will be considered by the Ministerial Committee on Science and Technology. Once approved by Ministers, it will be published. The purpose will be to set strategic objectives over a five to ten year perspective" (para 2.37).

15. The Levene/Stewart report (Review of allocation, management and use of government expenditure on science and technology by Sir Peter Levene and Professor Bill Stewart) made two specific recommendations which would have put OST at the heart of discussions on spending plans:

- OST should be responsible for working with spending departments and ensuring that Government priorities are reflected in their S&T spending plans (para 1.9)
- the CSA should take the lead in advising Government and the principal Cabinet committees on overall spending priorities for S&T and on the balance of spending across departments before a final public expenditure settlement (para 1.10).

But under the White Paper spending decisions will remain the sole responsibility of individual departments.

Role of Council of Science and Technology

16. The White Paper replaces ACOST and ABRC with a new body to take a much needed overview of science and technology and develop a strategy for science in the UK. The proposed Council for Science and Technology is to bring together "customers" of publicly funded research, industrialists, academics and business men and women.

17. It is vital if the government is to receive advice on the science and technology aspects of strategic policy issues of national importance that the Council is not only scientifically literate but also has a breadth of experience. Too often such committees are drawn from a narrow elite who have similar backgrounds, career patterns and perspectives. For example, the membership of ACOST was restricted entirely to men. Eight members are academics—professors and vice-chancellors; seven industrialists—one a Director of Research and Technology; and two consultants. Such committees need to encompass a broader spectrum of opinion—environmentalists, consumer groups, trade unions. It is also clear from the membership of the Committee of Inquiry into Women and Science and Technology and its Working Group that there are a number of able and qualified women scientists and engineers who could advise on the development of government policy.

Q3. *What are the relationships connecting Government funding of the Science Base, funding by industry and charities, and overseas funding (particularly from the EC)? Various people are "paying the piper": are they calling different or incompatible tunes, and if so is this a bad thing?*

18. On balance plural provision and funding is good, although it puts a premium on ensuring that the overview mechanisms under Q2 are effective. It also has to be recognised that in some areas the capital outlay required is so enormous that competing organisations may be extremely wasteful within a finite budget for the science base. Moreover, the fact that "pipers" sometimes call incompatible tunes cannot always be avoided, although the likelihood of that happening may be reduced by the production of a clearer overall strategy as envisaged in the White Paper.

19. As far as EEC funding is concerned there is considerable concern in the UK that the priorities set in the EC, and for which the UK research community pay via the Treasury practice of "attribution", may not be those which would be chosen in the UK. These problems have been well set out in successive reports by the Committee and again in recent oral evidence to the Committee by the SERC on the current issue. Unfortunately, the White Paper endorses "attribution" and makes no comment about the distorting effect that these policies can have on science spending.

20. While accepting that inevitably there will be some trade-off within the overall public funding available for science it is vital to ensure that the process has as little a distorting effect as possible, that the rules and their impact are transparent and acceptable. It also puts an added premium on ensuring that EC programmes provide genuine "added value" to UK science and that "subsidiarity" prevails.

21. Another problem in the context of the EC is the problem of securing a "level playing field" between the UK and EC research procurement directive "Scientific services" and possibly "R&D" although precise parameters are not yet clear, any tenders by public "customers" will need to be open to "contractors" throughout the EC. This will be unfair to UK contractors in at least two ways. Firstly, the funding structures are different so that, for example, public horticultural research establishments in Holland will be able to underbid for UK horticultural contracts because they have different "accounting" rules and have subsidised energy and rent. Secondly, UK public research funders and providers will be forced to put contracts out to

tender among other member states when the structure of research organisations in those other states, especially in France and Germany, is such that UK research organisations will not be able to bid for their research to anything like the same degree. This problem will increase as, following the White Paper, the process of competitive tendering for research in the UK will accelerate and the White Paper gives no indication that it recognises the problem or has a solution to it.

Q4. *What information and advice is needed by those who are setting priorities? How do they track developments overseas?*

22. The proposals in the White Paper for a Technology Foresight exercise and the Forward Look and the proposals made by the President of the Board of Trade for improving the machinery for identifying new developments overseas should, if effectively implemented, provide much more relevant information for decision makers.

23. It is also vital that the mechanisms for collating and disseminating the exponential growth in scientific information should be constantly upgraded. The OST paper on Intellectual Property in the Public Sector Research Base (London HMSO 1992) drew attention to the poor state of IPR awareness and lack of take up of patenting opportunities in public research organisations; a situation which the privatisation of the British Technology Group and the threatened privatisation of the UK Patent Office will do nothing to alleviate.

24. Moreover, the move to a much greater emphasis on commercial application, privatisation, and competitive tendering in research presaged in the White Paper will reduce the amount of scientific knowledge which is freely available and lead to increasing conflicts between the pressure to disseminate knowledge on the one hand and the need to protect commercial advantage on the other. It is quite common now, for example. to find scientists collaborating with groups overseas (especially in EC countries) and treating colleagues and former UK collaborators as the "opposition" and withholding useful interchanges of information. Although we all support international links, generating enmity between UK groups cannot be an efficient use of public money.

25. As we noted earlier government departments are the major public funders of R&D and there is therefore a major requirement for "intelligent customers" within departments with access to scientific and technical advice which is increasingly resident in the research agency or other research "contractor" and not in the sponsoring department. Under the customer-contractor rules to ensure fairness in bidding the departments will increasingly be unable to draw on the expertise of those most knowledgeable about a particular type of work. Such problems are particularly severe where, as in the case of nuclear energy, for example, the specialisation and rationalisation engendered by the highly capital intensive nature of the research concerned means that only AEA Technology, for example, will have the expertise, at least in the UK, to advise on contracts for which they are likely to be a prime contender.

26. As far as broader policy on S&T is concerned similar problems arise. Well over 50 per cent of government scientists now work in agencies. If present trends continue scientists working in OST will be a tiny island surrounded by a sea of administrators. In addition, the senior open structure (Grade 3 and above) statistics for 1992 show that there are still few scientists and technologists in senior policy making positions. None of the 20 permanent secretaries in charge of departments are scientists and only two have a specialist or professional background. Within the DoE of the 45 staff at Grade 3 or above only two are scientists*—the chief scientist and the head of the Building Research Agency. At the DTI, seven of 65 senior staff are scientists. Of these two are chief scientists and three are executives of research agencies.

27. If the senior policy making grades within government are to be "scientifically literate" then there must be mobility within and between departments, agencies and other public research providers. The fragmentation of the career structure, breaking the links between departments and agencies and privatisation of some or all agencies, and devolved pay arrangements will reduce even further the flow of high calibre scientists and technologists into senior policy making positions within government departments.

28. Although the White Paper says that "The Government recognises that science and technology are integral to the missions of many Departments, and that changes should strengthen the effective provision of scientific expertise and advice" there is no indication of how it will achieve that and all the indications are that their policies on market testing and privatisation will have quite the opposite effect.

Q9. *The Research Councils have explicit missions. How are these translated into priorities, by whom and on what basis?*

29. Research councils do have charters and corporate plans but this has not prevented the government from enforcing extremely rapid switches in priorities, such as the withdrawal of £31.5 million of funding by MAFF in 1988 following the government decision to cut funding for research projects deemed to be "near-market". This sharp cut in funding led directly to the loss of 1,500 scientific posts and the closure of a number of AFRC laboratories including the prestigious meat research laboratory at Langford, Bristol.

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*Note: "Scientific" as referred to here means those with a scientific/technical work background. Rather more may have a science based qualification but even that source is very meagre with only 17 per cent of recent entrants to the administration "fast stream" having STE qualifications.

30. It is to be hoped that the adoption of the more explicit mission statements described in the White Paper and the development of "concordats" will enable a more long term perspective and the stability essential for progress to prevail and prevent the worst excesses of "short-termism" in departments and the Treasury.

Q10. *How are the competing priorities of the different Research Councils (and the Royal Society and the Royal Academy of Engineering) reconciled within the limits of the Science Budget?*

31. Under the White Paper the ABRC will be wound up and its functions absorbed into OST under a Director General of Research Councils. It is to be hoped that moving the process of reconciling competing priorities "in-house" will not result in them being "in secret". The DGRC will be advised by a standing group of independent experts. As with the new CST, it is vital if the expert group is to function effectively, and OST receive the best advice, that the membership of the group is broadly drawn and representative of the scientific community which uses and is affected by research conducted by research council staff. It is also vital that its advice be public.

Q11. *Are the priorities of the Research Councils skewed by the boundaries between the Councils' remits, by the existence of Research Council Institutes, by international obligations to support "big science", or by anything else?*

32. Science will never fit into tidy administrative boxes whether on the basis of purpose/mission or discipline. Many current scientific advances are interdisciplinary and are in the areas between research council remits. This will continue to be the case even with the new boundaries which the White Paper has produced and there will be a continuing need for mechanisms to enable interdisciplinary and cross boundary work to take place. Nevertheless the fewer administrative boundaries between research areas, the fewer are the problems of cross organisation funding. The danger is always that work which could be funded by two organisations will be funded by neither.

33. We do, however, have some specific concerns about the way the boundaries are redrawn in the White Paper. Examples include:

(i) The possible downgrading of the importance of work on agriculture following the absorption of the AFRC into BBSRC. This is of major significance as much of the work undertaken by the AFRC would not be supported by the industry. Farmers are too fragmented to fund research and the "agri business" will not necessarily fund research such as that concerned with protecting the environment and public health by reducing fertilizer nitrogen inputs on farms.

(ii) That the division of SERC into the EPSRC and PPARC may lead to the creation of unnecessary and wasteful administrative and financial regimes which will divert resources away from science and technology.

(iii) The largest employment centres within SERC are the Rutherford Appleton and Daresbury Laboratories. Both institutions have facilities used by researchers carrying out work in areas which will fall within the remit of both new councils. It is as yet unclear whether a new regime of hard charging and service level agreements will need to be introduced. Such systems would be net consumers of resources in areas where financial constraints are already forcing the cancellation and deferment of "A" rated projects.

34. The Chancellor has asked Sir David Phillips to chair a group composed of experts in the field and representatives of research councils to consider the detailed allocation of responsibilities between Councils and to report by 16 July 1993 so that an announcement can be made at the end of the Parliamentary session. The timescale means there is little opportunity for discussion within and between Councils and there will be little or no public or Parliamentary consultation. Given the importance of getting the boundaries right and the issues satisfactorily resolved this is a ridiculously short timetable.

ANNEX 1

IPMS SCIENTISTS & TECHNOLOGISTS IN PUBLICLY FUNDED ORGANISATIONS WITH R&D FUNCTIONS

Public Research Organisations

AEA Technology
Agricultural and Food Research Council
CAB International
Countryside Commission
Countryside Council for Wales
English Nature
Forestry Commission
Horticultural Research International

Joint Nature Conservation Committee
National Radiological Protection Board
Natural Environment Research Council
Natural History Museum
Royal Botanic Gardens
Science & Engineering Research Council
Scottish Agricultural Colleges
Scottish Agricultural Research Institutes
Scottish Marine Biological Association
Scottish Natural Heritage

Government Departments and Agencies

Agricultural, Fisheries and Food, including:
  — Central Science Laboratory
  — Central Veterinary Laboratory
  — Veterinary Medicines Directorate
Defence, including:
  — Chemical and Biological Defence Establishment
  — Defence Research Agency
  — Meteorological Office
Environment, including:
  — Building Research Establishment
Health and Safety Executive
Home Office, including:
  — Forensic Science Service
Overseas Development Administration, including:
  — Natural Resources Institute
Scottish Office
Trade and Industry, including:
  — Laboratory of the Government Chemist
  — National Engineering Laboratory
  — National Physical Laboratory
  — National Weights and Measures Laboratory
  — Patent Office
  — Warren Spring Laboratory
Transport:
  — Transport Research Laboratory

Exchange of letters between the Clerk and Professor Alec Jeffreys

I enclose a copy of a recent report by this Committee on Forensic Science. The Committee did not look at DNA evidence in detail, but you will see that your work on DNA is referred to on page 43.

The Committee has now turned its attention to the much broader question of the Setting of Priorities for the Science Base. I enclose a note which explains what they are driving at. Lord Flowers, the Chairman of the Committee, wonders whether your experience with DNA profiling is a good example of a situation which does not match the linear model of research (ie the slow progress from fundamental science through strategic and applied science in the direction of the "market") on which science funding policy seems to depend. He would be interested to know how the forensic applications of your work first came to your attention, and what was the process whereby the close co-operation which now exists between academic biochemists, commercial firms and forensic investigators came about.

It may be that you can point me to published material which will answer Lord Flowers' questions. If not, I would be very grateful for a short note, with an indication of whether the Committee may publish it. You are of course welcome to respond more generally to the Committee's Call for Evidence if you wish to do so. I look forward to hearing from you.

29 *April* 1993

Thank you very much for your letter of 29 April and the enclosed report on Forensic Science from the Select Committee on Science and Technology which I have studied with interest.

I was interested to hear that the Committee is now turning its attention to science base priorities, and that Lord Flowers would like some further information on our development of, and experience with, DNA profiling. The details he requests are not available as such in any publication, and I have therefore set out my basic views on the matter as follows:

(1) Our work which led to DNA fingerprinting and DNA profiling was not in any way motivated by forensic considerations, but instead was concerned with a basic research programme addressing issues of variation and evolution in the genetic material of humans and animals. Part of the reason for studying DNA variation in man was to develop better markers for use in medical genetics (inherited diseases, etc.). DNA fingerprinting was an almost accidental by-product of this research, and it was only when we obtained our first DNA fingerprint, in September 1984, that the forensic implications both for identification and for the establishment of family relationships became obvious. Thus the development of DNA fingerprinting was a classic example of basic research solving a totally unexpected problem.

(2) Having developed this technology, we anticipated that, in view of its novelty, it would be years before DNA fingerprinting (and subsequently DNA profiling) could be applied to casework. Publicity in the national press concerning our invention however brought our work to the attention of lawyers who immediately saw the potential. Our first case, involving an immigration dispute, was brought to our attention by a London solicitor who had seen a report of our work in the Guardian. DNA fingerprinting brought this immigration case to a satisfactory conclusion and allowed a family to be reunited. This analysis was performed just six months after the first DNA fingerprint had been produced. News of the immigration applications immediately circulated through the immigrant communities and their representatives such as UKIAS, leading to a massive and rapidly increasing demand for DNA typing to resolve immigration disputes.

(3) By the end of 1985, we had performed the first paternity test and the evidence was accepted by a Magistrates court. Again, family lawyers created a major demand for typing in such disputes.

(4) The forensic implications of DNA fingerprinting were immediately obvious to myself and to my research group, and we entered into a collaboration in late 1984 with forensic scientists at the Home Office Central Research Establishment to see whether this technology could be applied to forensic samples such as blood stains and semen swabs. This research proved successful and was published in the scientific literature in 1985. Home Office forensic scientists then invested considerable effort in refining and validating the technology and applying it to forensic casework for the first time in late 1986.

(5) In late 1985, following on from our work on DNA fingerprinting, we developed the alternative technology of DNA profiling which is more appropriate for forensic analysis. By late 1986, we had carried out the first ever forensic investigation using DNA analysis on a double rape-murder case in Leicestershire. The eventual success of this investigation in unmasking the true assailant led to a major demand from police forces throughout the country for a DNA profiling service.

(6) In 1984, having seen the potential forensic and commercial implications of our work, we filled patent applications through the British Technology Group, with patent rights being subsequently transferred to the Lister Institute of Preventive Medicine, a biomedical charity which has supported much of our basic work that led to DNA fingerprinting. The Lister Institute then took a key role in seeking business advice concerning the establishment of a commercial DNA typing service. The Lister Institute and I identified ICI as the most appropriate licensee, and ICI subsequently, in June 1987, opened Cellmark Diagnostics, a subsidiary dedicated to providing a commercial DNA typing service.

(7) Through processes of consultation, exchange of genetic marker systems and scientific conferences, a close cooperation was established between forensic scientists in this country and abroad, both in the public and private sectors. This cooperation has helped in setting standards and in standardising the technology. The whole of this process of cooperation was driven entirely by the forensic scientists and the academics involved, and was greatly helped by the sense of excitement engendered by this new technology. In the early days, some friction between the private and public sectors inevitably arose as a result of patent applications filed to protect the technology, though these tensions have now been completely resolved.

The above items set out the historical sequence of events concerning the development of DNA typing in the UK. I would also like to make some additional points concerning this area:

(8) Commercialisation would have been very difficult had we not filed patent applications on our discovery. Patenting creates a major conflict for academics who have to balance on the one hand academic freedom and the free discussion of results, and on the other hand the degree of secrecy

needed to prevent prior disclosure and thereby invalidate any future patent applications. It was only because the immediate lead-up work to DNA fingerprinting occurred extremely rapidly, within the space of a few months, that we did not inadvertently disclose information and therefore prevent the subsequent process of patent application. In this respect, patenting in the UK, which demands no prior disclosure, places UK scientists at a significant disadvantage compared with, for example, colleagues in the United States where the prior disclosure strictures do not operate. My view is that a fundamental review of patent regulations in the UK is desperately needed.

(9) The development of DNA fingerprinting is a classic example of fundamental research serendipitously yielding important applications that in no way could have been predicted from the lead-in research programme. The development of DNA fingerprinting most certainly does not match the linear model of research and also highlights the importance of having mechanisms in place which enable academics to obtain rapid information on patenting and commercialisation, and for organisations to be available which can take the burden of responsibility for these operations off the shoulders of the academic, who is most unlikely to be skilled in business and patent law.

(10) In my view, the development of DNA fingerprinting provides a good example of the importance of maintaining a flourishing, independent and academically free research base in Universities where work can proceed on fundamental issues that are not necessarily driven by clearly defined research goals. It is in the nature of basic science that many developments of importance cannot be predicted and therefore would not be developed through goal-orientated strategies. I note with dismay the continuing erosion of the project grant system operated by Research Councils which provides the life blood for almost all basic research in Universities and very nearly the sole means by which young academics can launch a research programme. The steady drift of Research Council funding away from small research groups, which have historically yielded many of the important developments in UK science, is a matter of deep concern and, in my view, requires in depth review.

(11) Finally, continuing from the above point, I would note that the great strength of UK science lies with the imagination and ingenuity of the lone scientist or the small research group. UK science has never, in my view, flourished in large consortiums to anywhere near the extent that it does in other countries, most notably the United States. I believe that it is important to recognise this fundamental aspect of British science and to provide a funding environment that is more supportive of the small, independent research group. Had Darwin been alive today, I shudder to think of the funding problems with which he would have been faced!

I hope that these comments might be of some use. Please let me know if you need any further information or comments.

Professor Alec Jeffreys.

5 *May* 1993

Memorandum from the Natural Environment Research Council

SUMMARY

NERC's Mission is "environmental science". Its overall aim is to promote and support an integrated approach to the whole spectrum of research, survey and training in the natural environmental sciences and to secure a strong, innovative and flexible base of cost-effective environmental science for the benefit of the UK.

NERC has always been concerned to see the successful application of its research both in relation to enhancing national competitiveness and quality of life. Considerable efforts have been made over a number of years to promote the links between environmental science and its application to users in government and also in the business community. Collaborative research and training is pursued and contract research undertaken.

NERC takes a medium to long term strategic view of research and survey requirements. The published science strategies with a 5-10 year horizon, are a public expression of this "research foresight" activity and are developed with inputs from all quarters of the science and user community. Progress is reviewed annually as part of the corporate planning and forward look process, and priorities adjusted as necessary.

Priority setting for research training has historically been largely demand-led. Results are closely monitored, however, and new MSc courses supported and old courses dropped in response to changing need. A small targeted scheme has been introduced in recent years to address areas of shortfall.

NERC operates a flexible system of support to enable response to new developments at the same time as allowing support for the important base of longer-term strategic research and survey which may not be currently "fashionable" but which nevertheless needs to be maintained in the national interest. Over the three years 1994–95 to 1996–97 approximately 38 per cent of NERC's direct expenditure on science is expected to be recycled.

NERC supports research and training through the most appropriate route and wherever the relevant expertise happens to be located. Its targeted Community Research Projects and Special Topic programmes are open to the whole research community.

We have welcomed the publication of the White Paper and believe that many of the "foresight" procedures and priority setting mechanisms already employed within NERC are well within the spirit of the White Paper's intentions. Whilst we would have wished to see greater overt reference to quality of life as an important national need, we support the need also for harnessing the nation's S&T talent for wealth creation. Environmental science contributes both directly and indirectly to wealth creation and wealth conservation; we look forward to further developing our links with industry and commerce to this end.

Q1. *What is public expenditure on the Science Base for?*

1. The aims for Science Base expenditure are the advancement of knowledge and technological capability through excellent science, the development of skills through training, and the application of knowledge and skills to achieve economic, social and cultural benefits.

NERC supports the White Paper emphasis on the need to harness expenditure towards wealth creation, and will continue to develop its collaborative links with industry and commerce to these ends. However, there must also be a parallel emphasis on wealth conservation and on improvement in the quality of life. It is important that the new concentration on wealth creation does not lead to these areas, which are so vital to the achievement of sustainable development, being eclipsed in the priority setting process.

Q2. *What are the objectives and priorities of the various funding agencies within government—Research Councils, HEFCS, other departments. Are they related? Is an overview of government funding required, and do the existing structures provide it?*

Research Councils and Government Departments

2. The emphasis of Research Council objectives and priorities for funding from the Science Budget has been on basic research, longer-term strategic research and survey related to national needs, and postgraduate training. Applied research has also been carried out, normally under contract to other public and private sector organisations. The main emphasis in Government Departments has been on research in support of specific areas of Departmental policy, statutory, regulatory, operational or procurement need.

The White Paper has now set out clear Science and Technology Mission Statements for Government Departments and revised Mission and User Community Statements covering the reorganised Research Council structure. This is a helpful development. The reference to a responsibility for applied research within the Research Council missions is new; however, NERC would continue to expect such research to be supported jointly or under contract as well as through Science Budget funding.

3. The area of Research Council/Departmental interaction that NERC has flagged up in the past as a concern, is the position of strategic science. Research Councils have funded such science where it relates to high priority scientific and technological need. Government Departments also have requirements for strategic science in relation to their longer-term policy, regulatory and other objectives. Departments have been generally good at identifying their short term applied needs but, with some exceptions, less good at analysing and making provision for their more strategic long term requirements. In times of financial stringency, there is a quite understandable tendency to be more concerned with short-term requirements than with the science that will meet future requirements, The concern is that this could well lead to the situation where there would be a national policy need for scientific advice which could not be fulfilled satisfactorily because the underpinning science had not been supported.

NERC therefore welcomes the White Paper's recognition of the importance of a strategic approach and the need to develop more long term strategic thinking within Government over a five to ten year timescale. We also welcome the intent to publish an annual Forward Look.

4. In the NERC input to the consultation on the White Paper, we suggested that one mechanism for helping to introduce more long term strategic thinking on research needs and at the same time strengthening the Research Council/Departmental interface, would be through full representation of appropriate Research Councils on Departmental Advisory Boards. This would have mirrored the present system of membership and assessorship of Departmental Chief Scientists and their representatives on Research Councils and Council Committees.

Whilst the White Paper has not taken this suggestion on board, it has proposed that Concordats be developed between Research Councils and those Government Departments with which they have significant links. NERC would aim to use development of these Concordats to, inter alia, pursue the best mechanism to develop two-way advisory inputs on longer-term research needs and future plans.

Research Councils and Universities

5. In addition to their teaching commitment, the Higher Education Funding Councils (HEFCs) contribute, under the dual support system, towards the support of basic research undertaken by university staff, and provide an infrastructure which helps to support grant-aided basic and strategic research and training funded by the Research Councils in the universities.

As a firm supporter of the dual support philosophy, NERC welcomes the White Paper's reaffirmation of this system.

6. The NERC input to the consultation on the White Paper expressed concern at the lack of an interface within the national structures for science and technology between Research Councils and the HEFCs, as the funding agencies responsible for the maintenance and delivery of a healthy science base. We proposed the replacement of the Advisory Board for the Research Councils (ABRC) by a Board for the Science Base involving the Research Councils and HEFCs in partnership.

NERC therefore welcomes the White Paper's proposals for the establishment of a new co-ordinating committee for the science and engineering base as well as increased cross-membership between the Research and Higher Education Funding Councils. We would hope that the Research Councils will have direct representation on the new co-ordinating committee.

Q3. *What are the relationships connecting Government funding of the science base, funding by industry and charities, and overseas funding (particularly from the EC)? Various people are "paying the piper": are they calling different or incompatible tunes, and if so is this a bad thing?*

7. NERC is a firm believer in maintaining a plurality of funding sources. We do not see this as a problem.

8. Both industry and charities can provide significant funding for the Science Base in certain areas. Industrial research contracts are generally highly targeted towards specific market applications. However, development of collaborative partnerships with industry and involvement of industry at an early stage in the research development process, enables a more strategic focus, and helps a two way transfer of knowledge, technology and needs between the science base and industry.

In line with the White Paper, NERC looks forward to developing even further its existing links with industry and commerce through its own mechanisms of collaborative research and training, contract research, and promotion of environment science capabilities to the business community both nationally and locally, and also within wider Government support mechanisms such as LINK.

9. Funding by the European Commission (EC) has hitherto focused on research required to underpin the Commission's policy and regulatory functions, on encouraging generic technologies with a broad range of application, establishing industrial standards, and ensuring a mobile supply of skilled researchers. The EC is now increasing its interest in the funding of basic research. The NERC view is that this is appropriate where there will be an added dimension from European coodination, for example where there are economies of scale or where the issue is transnational in character. In other instances the principle of subsidiarity should apply.

NERC welcomes the White Paper's proposals to draw industry and the science and engineering base more effectively into its policy thinking on future EC Framework Programmes. NERC has already been involved in such discussions, submitting views to OST on the possible shape of the Fourth Framework Programme and participating directly in detailed discussion of the environmental content of that Programme. We look forward to enhanced involvement in the future.

Q4. *What information and advice is needed by those who are setting priorities? How do they know what is going on in current low priority fields? How do they track developments overseas?*

10. This question is addressed in the following sections which deal specifically with the questions addressed to the Research Councils (Questions 9–12).

Q9. *The Research Councils have explicit missions. How are these translated into priorities, by whom and on what basis?*

The NERC Mission

11. NERC has always been a mission-oriented Research Council and its Mission has been clearly stated in successive Corporate Plans. The White Paper has provided NERC with an extended remit and a re-stated Mission, placing special emphasis on "meeting the needs of the users of its research and training output, thereby enhancing the UK's industrial competitiveness and quality of life".

We welcome the Government's commitment in the White Paper to maintaining NERC as the focus for support of environmental science in the UK. We also welcome the additional responsibility placed on NERC for earth observation. This will allow this key area of science to be developed closely in line with the needs of the user community. NERC has always been concerned to take account of national needs and we have no difficulty with the explicit reference to this in the new Mission statement. We welcome the specific reference to enhancing the quality of life and would reiterate the point made in para 1 that this must be accorded equal emphasis to wealth creation in the national priority setting process.

Setting Scientific Priorities

12. The focus for NERC's planning for its Science Budget support for the environmental science base is on basic and strategic research, survey, and associated technology development. Account is taken of scientific need and opportunities on both a national and international basis, and also of perceived national needs.

NERC welcomes plans in the White Paper to introduce a process of "foresight" into Government thinking about national research needs and hopes for a direct involvement in that process. The Council is concerned, *however, that the foresight activity should not be restricted to a too narrow interpretation of "technology". Other important national needs relating to sustainable development and quality of life must not be neglected.*

13. NERC's own "research foresight" activities are expressed through the development of its science strategies with a 5-10 year horizon, and the annual corporate planning process. They were the subject of very favourable comment in the recent OST publication "Research Foresight and the Exploitation of the Science Base".

14. The present series of six Science Strategies, were published in the late 1980s. A programme of updating is now in hand with a view to the publication of revised documents in mid 1994. The Corporate Plan is updated and published annually. It includes a review of progress in implementing the strategies and in meeting specific targets, and reports on any rescheduling of priorities to take account of new scientific developments and opportunities.

15. Various expert groups and ad hoc topic review groups provide a grass roots input into the priority setting process, working up through the Council's main advisory committees and the British Geological Survey (BGS) Programme Board to Council itself. In addition to the participation of key external and internal scientists, representatives from Government Departments, industry and other Research Councils are involved as appropriate. This enables the wider perspectives to be addressed and helps to promote interaction and consolidation of common interests. NERC senior staff, and in particular the Directors of Science, play a major leadership role in the process. They keep au fait with their sectors by the usual means of personal contacts and visits, discussions with other funding agencies, government laboratories, industrial contacts, national academies and others overseas, conferences, journals etc. This intelligence enables a significant proactive input to NERC's foresight activity and priority setting.

Setting Priorities for Research Training

16. NERC provides skills training for the environmental science base and industry through both the MSc and PhD routes. This area has been given a high priority by Council and its Higher Education Affairs Committee, with increased costs being met by redeployment of baseline funding.

17. The provision of studentships in support of advanced courses leading to the MSc degree is given high priority, both in terms of the importance of such courses as vocational routes into the provision of skilled manpower, and the conversion of graduates to research and employment opportunities in new areas. Some 211 MSc students are currently supported. The relevance and success of the courses is monitored closely, and new courses supported and old courses dropped in response to changing priorities. Greater industry involvement in the funding of MSc courses is being encouraged. Funding for PhD research studentships is provided mainly in responsive mode. This mechanism, which includes the NERC scheme of Co-operative Awards in Sciences of the Environment, many of which are co-operative with industry, currently supports some 900 students; a further 20 students are supported under NERC Special Topics.

18. In 1990, concerns over the shortfall in training researchers in some areas led Council to give high priority to providing a small number of additional MSc and PhD studentships targeted to areas of particular need identified through its planning process. A new focus aimed at stimulating links with industry has now been introduced for the 8 PhD research studentships currently available under this targeted scheme. The studentships are awarded to University/Research Council Institute /Industry consortia, and require at least 40 per cent of the student's time to be spent in the industrial workplace.

NERC views the White Paper's proposals on research training with great interest and will grasp the opportunity provided critically to re-examine its policies for the support of postgraduate education. The Council has already been piloting the idea of one year MSc + three year PhD studentships in order to give scientists from the basic science disciplines a grounding in oceanography or atmospheric sciences before proceeding to a PhD. There may well be differing views on the best way to introduce the MSc as a pre-requirement for proceeding to a PhD in all cases. Increased numbers of MSc studentships will also impact on the number of PhD awards that will be available within a fixed funding scenario.

Relative Priorities of Funding Types and Mechanisms

19. NERC supports the Science Base through a number of different funding routes:

(i) NERC responsive mode grants, studentships and fellowships, supporting unsolicited individual environmental research and training proposals of the highest intellectual quality as judged by peer review.

(ii) NERC Special Topic grants and studentships, supporting individual proposals of equivalent quality solicited by NERC to address a strategic area of importance and timeliness to science and/or to the nation's interest.

(iii) Units and Centres established by NERC as centres of special expertise within a defined area of work. These are mainly located on university campuses.

(iv) NERC Institutes, supporting longer term strategic research, observation and survey programmes and associated developments in instrumentation, methodology and data handling.

(v) NERC Community Research Projects (CRPs), supporting multidisciplinary teams drawn from many UK scientific institutions to focus, by means of an agreed scientific plan, on a particular scientific question.

(vi) Scientific Support Services established by NERC to provide the environmental science community with access to uptodate facilities and services.

NERC institutes also receive support from external customers for commissioned research and advice.

20. Questions are often raised about the relative priority that should be given to these various different types of funding, and in particular the balance between responsive and targeted research, between research in universities and research institutes, and between Science Budget and commissioned research.

21. In respect of Science Budget funding, NERC's aim is to maintain sufficient flexibility to allow science priorities to be supported through the most appropriate route and wherever the relevant expertise happens to be located. In our 1993 Forward Look submission to ABRC, we estimated that, over the three years 1994–95 to 1996–97, approximately 38 per cent. of NERC's direct expenditure on science (Science Budget less expenditure of Headquarters, pensions and major capital) would be recycled in terms of existing activities, projects and grants coming to an end or reducing in size, and being replaced by new ones.

22. In respect of external funding, there is careful monitoring by NERC management of the balance between Science Budget and commissioned activities in Council's research institutes, in order to ensure that the health of the basic underpinning science is not eroded. More than half the costs of some institutes are currently met from commissioned research income.

Q10. *How are the competing priorities of the Research Councils (and the Royal Society and Royal Academy) reconciled within the limits of the science budget?*

23. NERC, along with the other Research Councils, has submitted a published Corporate Plan and confidential Forward Look to the ABRC in February each year. These documents are generated within Council through the NERC planning process, and represent the outcome of the continuing review of scientific progress and priorities undertaken through the various advisory committees and review mechanisms employed. They provide an overview of corporate and sectoral objectives and targets including: priorities for funding within the baseline resources available; the extent to which it has been possible to accommodate new priorities within baseline and the science that has been reduced or terminated; and the priority items that, for one reason or another, cannot be accommmodated within baseline, but which remain a high priority for support.

The White Paper has signalled the internalisation within OST of the cross Research Council assessment and resource allocation functions hitherto carried out by ABRC. A new Director General of Research Councils (DGRC) within OST will undertake this task, advised by a standing group of independent experts. NERC regrets the passing of an independent advisory body for the science base and hopes that this will not lead to greater politicisation of science and increased secrecy. The reconstituted ABRC achieved a great deal in terms of better collaboration and co-operation between Research Councils since 1990. In the view of the NERC Chairman, the main difficulty with ABRC was that the independent members had not been asked, or given the financial support, to make the time commitment needed to inform themselves fully. It is to be hoped that this misjudgement will not be repeated with the DGRC's standing group of independent experts.

Q11. *Are the priorities of the Research Councils skewed by the boundaries between the Councils' remits, by the existence of Research Council Institutes, by international obligations to "support science", or by anything else?*

Constraints on NERC Planning

24. NERC's freedom to allocate its Science Budget resources is constrained principally by:

(i) the Government's earmarking of funds for the British Antarctic Survey (BAS), which continues to receive a "ring fenced" allocation. Whilst scientific priorities can be and are set within this area, the budget is not available for re-distribution to other areas. In 1992–93 "ring fencing" for BAS amounted to 18 per cent of the total NERC Science Budget allocation.

(ii) increases in the numbers of retired NERC staff and cost of pensions; these continue to cause the pension provision to grow at a rate greater than the Science Budget. In 1992–93 pensions accounted for some 5 per cent of the total Science Budget spend.

25. A further factor is the result of the dual support transfer with its "irreducible minimum" level of research grant support to which Council has been committed. Although this does not conflict with the NERC policy of maintaining support for universities, it does constrain the ability to move funds within the present university support baseline, for example from grants to postgraduate training.

The White Paper's proposals on adapting grant making arrangements and provision of support for promising researchers through fellowships rather than specific project grants will require a re-appraisal of this present constraint.

Research Council Interfaces

26. Our priorities are driven by NERC's environmental mission. Within the science base many of our priorities are free-standing because much of our core science, on a national scale, is essentially NERC's responsibility alone. However, some of our priorities have been at the interface of interest with other Research Councils, and interfaces will still exist even after the reorganisation following on the White Paper. We do not see this as a problem. In the recent past, where Research Council priorities have fully coincided, collaborative programmes have been developed; where the main interest has been in one Council, that Council has taken the lead but opened up the programme to the whole science community on a competitive basis; where there were common interests but different objectives and targets, parallel programmes were pursued with linkages developed as appropriate.

Research Council Institutes

27. Support through Research Council Institutes enables Council to provide some stability for the important base of longer-term strategic environmental research and survey which needs to be maintained in the national interest. NERC's research institutes do not work in isolation. They frequently work in very close association with university scientists and provide vital core support, as well as a significant research input, to some of NERC's highest priority Community Research Projects, which bring together scientists from the whole environmental science community.

28. Stability of support is not synonymous with a static approach. The aim is to pursue high quality science as judged by stringent external peer and merit review, and to maintain sufficient flexibility so that changing priorities can be accommodated. Expenditure is scrutinised annually to identify work coming to a natural end, or work which is no longer of the highest priority, so that funds can be released to enable new, higher priority work to be started. An increasing number of staff in NERC institutes are employed on Fixed Term Appointments. Such appointments now represent 23 per cent of the total NERC complement and will continue to play a key role in our manpower policies.

We note the reference in the White Paper to the Government intention to commission a scrutiny of public sector research establishments with the aim of increasing the effectiveness of resource use. However we also note that the Review of Allocation, Management and Use of Government Expenditure on Science and Technology, which led to this proposal and which was published simultaneously with the White Paper, was impressed by the variety of funding mechanisms used by Research Councils to allocate resources and by the way Councils had managed their role as both customer and owner of institutes. We welcome these comments and the team's recognition that our research institutes were "creating a special research culture that arises from attracting a critical mass of researchers who can dedicate themselves to research full time. This, and the freedom to pursue more speculative work that comes with long term support, generates research of the highest quality". We believe that NERC's institutes have already demonstrated their effective use of resources. In the light of this and their clear relevance to NERC's new mission, we would not expect to see them in the list of research establishments selected for scrutiny.

International Collaboration

29. NERC regards international collaboration as an opportunity to be seized rather than an obligation, and as a means of promoting high priority research, particularly that with a global or regional dimension. Much of the research funded by NERC is carried out within an international context and pursued through formal and informal bi and multi-lateral associations.

30. We have commented already on EC research (see para 9). In the wider international setting NERC provides a focus for the more formal contacts such as UK participation in the Ocean Drilling Program (ODP), and also for UK contributions to the major global environmental science programmes. Only ODP is a potential "constraint" insofar that it is a major facility subscription-based programme, but there are clear break points where decisions whether to continue or pull-out are based on assessment of scientific priority. The high priority accorded to ODP at the last review, in 1991, led to a decision for continued UK participation for a new phase, starting in 1993.

31. For many of the international environmental programmes, the UK is in the lead in helping develop scientific ideas and in ensuring their scientific validity. The rationale for participation is to concentrate on those programmes where the UK has particular strengths and can make a world class contribution. NERC supported scientists are particularly active in the major global change programmes including the World Climate Research Programme (WRCP) and the International Geosphere-Biosphere Programme (IGBP). It is important that such multi-national research has clear goals and built-in review points. UK contributions have to stand up to scrutiny in the same way as any national programme and be justified on the basis of high priority, excellent science.

Q12. *How is the money transferred from the UFC to the Research Councils being spent?*

32. This money is being spent entirely in support of research grants to universities, both in responsive and targeted mode. Dual support funds have not been used towards support of NERC's intramural activities or other areas of NERC spend.

33. The aim of the Dual Support Transfer (DST) was to enable Research Councils to support the full costs of research (excluding academic staff, premises and central computing) within the research grant. The additional funds made available to NERC through the transfer were:

1992–3	1993–4	1994–5
£2.9 million	£8.4 million	£10.0 million

In line with the terms of the transfer, an "irreducible minimum" of grant support was established in cash terms appropriate to the amount of the transfer. NERC is currently funding grants in excess of this minimum.

34. We are aware of the concerns expressed by some individuals and institutions that lesser amounts of money than they had expected seemed to be flowing to them under the new arrangements. Some of these concerns have been found to be based on misconceptions, others seem to stem from an incomplete understanding of the new arrangements by those preparing grant applications, and others from inaccurate information. The Research Councils have been concerned to ensure that institutions are fully aware of the new arrangements and have jointly been issuing a series of newletters explaining the position. The latest and fourth Newsletter in this series, has re-emphasised the arrangements now in place and given details of the ongoing monitoring and review of the system by the Research Councils, including the intention for a detailed review in mid-1994.

The White Paper makes a number of proposals for Research Councils to adapt their grant-making arrangements to help universities to improve the career opportunities of research staff. NERC is very sympathetic to this need and we will be re-examining our policies for research grants and also the balance between support for specific projects and fellowships. As already noted (para 25) this may impact on the "irreducible minimum" of grant support.

Letter from the Royal College of Physicians

The Royal College of Physicians is grateful for the opportunity to present evidence to the Select Committee on this topic. We do this from the standpoint of our principal objective which is the maintenance and improvement of the standards of patient care. In attaining this objective, we are critically dependent on advances in biomedical and social sciences, at all levels, from the most basic to the clearly directly relevant applied science. Below are our comments on some of the questions raised, numbered as in the original Call for Evidence.

1. *What is public expenditure on the Science Base for?*

Basically, to ensure national prosperity for both the medium and long term future. The facet of prosperity of most direct concern to the College is the "Health of the Nation". The government is accountable to the public for its expenditure on science, but has the problem that far too small a proportion of the population understand what science is about, let alone for. In particular, they do not understand the long term scale from basic research to practical application. We therefore strongly recommend that efforts to educate the public in the processes and time scale of science are strengthened.

2. & 3. *Objectives and priorities of the funding agencies and their interrelationship*

It is an inevitable consequence of financial stringency that funding agencies within Government Research Councils, HEFCs and Departments of State move to a more dirigistic style of research management, determining priority areas for funding and adopting a more proactive stance in funding research. There is an implied assumption that this course of action will achieve better value for money. But this assumption remains unproven. In a well-known analysis of seminal advances in cardiovascular medicine it was demonstrated that just under half the projects leading to those advances were not directed at solving the particular problem which eventually was solved. On the other hand, the heavily prioritized and managed AIDS programme has had some success; but we do not know whether the success would have been more conspicuous if the programme had not been so directed. What is certain is that the antecedents of most major advances in medicine trail back decades or longer and both basic and clinical science contributions are heavily represented along the route.

We do not know how to strike the correct balance between a priority driven programme of national research and funding one mainly based on the good scientific ideas with or without obvious applications in mind. It appears to us essential that governments should support both approaches. Our plea is that the criteria of "usefulness" should not be taken too far overall, lest we sacrifice the longer term future to more immediate "fire extinguishing". We do, however, accept that it is more appropriate for proactive, priority driven research to take place in the setting of the NHS R & D programmes and similarly appropriate for the Medical Research Council to pay greater attention to proposals of intrinsic scientific merit, whether or not they appear relevant to immediate problems of the day.

We note, with approval, that the HEFC's support of science in universities, now justifiably based on indices of past performance, is not specifically polarized towards either basic or applied science.

It is clear that some overview is required, but we would not wish to see a more dirigistic stance adopted than currently taken by the extant structures.

We also believe it essential that science is supported by a variety of agencies calling different tunes. At the national level there is a danger that a more unified structure will become too polarized in its approach to science funding. At the level of the individual research worker or groups, it should remain the situation that if a good application fails when submitted to one agency, there should be the opportunity of resubmitting to another agency of different stance, though having equally stringent requirements for scientific excellence.

4. & 5. *Advising the priority setters—examples from charities and companies*

The essential principle is to seek advice very broadly at all stages of planning. This is the best way of ensuring that promising developments in current low priority fields come to light and of maintaining awareness of overseas developments. The medical research funding charities are mainly focused on specific classes of diseases (with a few exceptions, notably the Wellcome Trust). Their overall priorities are set by their terms of reference, and it is doubtful whether the government has many lessons to learn in how to set priorities from this source. In general, the charities tend to support good science in their fields and do not devote a major proportion of their funds to pre-determined priority issues. Industry has more specific responsibilities to shareholders and gives obvious priority to relatively near-market research but in the medical field there are notable examples of seminal research emanating from in-house more basic research in pharmaceutical companies, and it is quite common for more basic biomedical research in universities to be supported by industry if it is perceived that there may be a long term benefit to the company concerned.

THE UNIVERSITIES

6. *HEFC priorities*

The College is aware that HEFC policy is to support research selectivity and notes the methodology of successive Research Assessment Exercises to this end. The priority of the HEFC is to support well-found research, which has the critical mass to be or become internationally competitive. But the HEFC does not indicate the precise distribution to be followed in allocating its block grants for research. It is well aware that universities would be imprudent not to, for the most part, direct the block grant selectively on the basis of the last Research Assessment Exercise. This system is a good one, because its imprecision allows some of the funding to go into the support of speculative pilot studies which are not yet ready to compete for external grant support.

7. *How do Universities distribute the block grant between Departments?*

Many universities, including medical schools, not only choose which research to support selectively, but do so on the basis of a variety of formula, designed to reflect research rating and external funding acquisition. In the medical field there is an increasing view that the traditional departments, which may still be the best way to deliver teaching, are not the best basis for the organisation of modern medical research. More appropriate are mult-disciplinary inter-departmental groupings and some medical schools are selectively funding such groupings. This makes for particular difficulties in participation in Research Assessment Exercises which prescribe for returns to be made by departments, or specified groups of departments.

8(b) *The impact on priority setting of regionalisation of funding*

This question is pertinent to the Department of Health's R&D initiative in which there is developing substantial regionalisation of funding through regional directors of R&D. It is difficult for many to understand the rationale of this approach. Most regional research in the NHS is relevant nationally as well as regionally, and there seems little point in such research being directed by a region, which cannot have so effective a research management organisation as a national organisation. Though this problem theoretically should not affect priority setting, it may do so indirectly by making less practicable otherwise high priority research.

8(c) *The shift from core funding to project funding*

It is too early to assess the effects on priority setting. But in theory it is likely to reduce the flexibility for mounting pilot projects, and feasibility studies in high priority topics may not take place.

8(d) *The effects on priority setting of the moves towards an R-T-X model*

The College believes profoundly that no medical school which was merely T would be worthy of the name. A prime essence of medical education is the inculcation of the spirit of enquiry. It cannot be taught by recipe or by rote. We do not believe that all departments or academic staff in a medical school should necessarily undertake research, but some should, and to a high level for the sake of the teaching as well as the research itself. R and X are satisfactory, T is not, so far as medical schools are concerned.

9. *Missions of the Research Council*

Our principal knowledge is, as might be expected, related to the Medical Research Council. Particularly since the recent Concordat with the Health Department, there is an explicit influence of Health Department priorities on the distribution of funds. But such influences are, quite correctly, only brought to bear after the scoring of an application on purely scientific grounds. There is no point in funding bad science. There is no evidence at the moment that the Health Department influence is unduly distorting the balance between basic and applied science, though it is intrinsically impossible to say whether it is inhibiting the development of scientific ideas which in the long term may have major medical and social impact.

Professor L A Turnberg MD, President

9 *June* 1993

Memorandum from the Royal College of Physicians of Edinburgh

It seems appropriate that the College responds only to the general questions (1–5 inclusive).

1. **What is public expenditure on the Science Base for?**

Answer: It should be to:—

(a) To promote exploration and the acquisition of new knowledge to mankind.

(b) To promote the use, when appropriate and possible, of this newly acquired knowledge for the benefit of mankind.

(c) To promote the use of this newly acquired knowledge for the benefit of the people funding the public research.

2. **What are the objectives and priorities of Government funded research?**

Answer: The objectives and priorities of the various funding agencies are not clear nor is it clear whether they are related. An overview would be an advantage. There is little evidence that existing structures provide it or that they operate in the context of a harmonised and co-ordinated whole.

3. **Incompatible Tunes**

Answer: It would be unreasonable to expect compatibility to the point of identity. A mix of perspectives (see 1(c) above) is acceptable, inevitable and not a bad thing.

4. **Information and advice on setting priorities**

Answer: The acquisition of information and advice on scientific advances is a matter of major importance and required significant investment and application of skills. There is little evidence that these investments are being made and that this topic is ranked as a high priority in government funding agencies. Too often we are unable to switch rapidly to a current low-priority field because someone has "a hunch" that it will be a high-priority field in five years time.

The tracking of developments, whether at home or overseas, requires sustained and skilled examination of a series of databases, including those associated with patent offices.

5. **The funding of research by charities and companies**

There is sufficent evidence to suggest that the successful charities and companies are those who focus their research activity, but focusing the interests of government is much more difficult.

Letter and Memorandum from the Save British Science Society

I enclose a brief memorandum clarifying our position on two of the matters which we feel were left in an unsatisfactory state last Wednesday when we gave evidence before Sub-Committee I (*see p26*).

We realise that in the context of the present enquiry you may still regard these responses as not very helpful. But SBS has its origins in a realisation by many scientists of different disciplines that the degree of underfunding which had developed by the mid '80s was having an increasingly divisive effect within the scientific community, going beyond a naturally strong dedication to one's own field over others and towards a breakdown of a common sense of purpose in the advancement of science.

As opportunities for new science were, at the same time, expanding rapidly in all fields frustration mounted. Ministers earnestly sought advice from supplicants about which other area of research should be cut to provide for their needs. No one was winning except the Treasury. Leadership was lacking, with the Royal Society either too aloof or, probably, as divided as the community. No one appeared to be making the case for science as a whole, and Ministers told some of us that there was no hope of change unless public interest in the needs of science was raised.

The situation is not much improved, although the House of Lords Select Committee has produced some outstandingly good reports and the Royal Society has been rather more ready to speak out under its Presidents of recent years.

SBS has always made clear to its members and others that it is not in the business of saying which areas of science should next be sacrificed for the benefit of others. What is needed is more people, more scientists, making the positive case for adequate investment in science as a whole.

J. H. Mulvey
Executive Secretary

26 *April* 1993

In this memorandum we wish to clarify our answers to two important questions asked during the giving of oral evidence on 21 April 1993.

Q1. *How should priorities for the science base be set, in particular should the present system be changed?*

A. In parallel with the setting of priorities through the ABRC/Research Council system it is in our view essential for the vitality of the science base that there is:

(1) Devolution of responsibility for choice wherever possible to the individual researcher. In the universities this requires restoration of an effective, adequately funded, dual support mechanism. This approach would help to seed original research, to sustain unfashionable areas of research, and also to give opportunities to younger scientists.

(2) Maximum plurality of funding sources and mechanisms.

(3) Support of individual excellence.

(4) Greater recognition of the *training function* of the science base.

Our prime concern is to return to more "bottom up" setting of priorities, and hence our insistence on the importance of dual support. We are not convinced that structural changes, at the Research Council level, will bring any major benefits. These mechanisms are probably as good as those of most countries. The problem is lack of money causing—as the ABRC has said—too great a narrowing of the research base.

Q2. *What should be the priorities for the science base, assuming no increase in funding?*

A. SBS believes that *increased financial support* is the first priority, to enable the science base to exploit fully today's opportunities and increase its ability to contribute to national wealth. SBS speaks for the science base as a whole, and does not enter the discussion of relative priorities. All sectors of research are seriously underfunded.

We argue that the way to a more competitive, wealth creating industry is through a vigorous expansion of the industrial research base, and not by concentrating more SERC funds on research of supposed relevance to industry. In the absence of the former, the latter would be doubly futile.

Letter from the Science and Engineering Research Council

What is the impact on your decision-making of the following:

(i) the boundaries of your remit;

(ii) scope for collaborative funding;

(iii) any other intrinsic factor which you wish to bring to our attention.

Some of these issues are touched on during our hearing with the Select Committee on 24 March (*see p14*). A full answer would be very long so it may be better to emphasise some particular concerns:

(i) the boundaries of SERC's remit are not well-defined: the Charter gives SERC virtually unbounded ability to support any area of science and technology. It has been the practice to regard SERC as "residual legatee" for any area of science and technology which the other Research Councils do not regard as falling within their mission-oriented remits. This has caused SERC some problems in planning a balanced and sensible programme, especially in fields that impinge on the other Councils. We would like our remit to be much more clearly focused.

(ii) we pursue collaborative funding where we believe it is in the national interest to do so. Major collaborations are with DTI (in IT, Teaching Company, LINK, biotechnology, etc); other Research Councils and Government Departments; and through international facilities and partnerships (eg, CERN, ILL). Collaborations of this kind require nurturing and commitment and can involve a culture clash. They can limit our flexibility but can bring a substantial "gearing" to bear on the funds we can make available. SERC has always taken a very positive approach towards seeking collaborative funding, especially from industry, and has vastly more activity in this regard than the other Councils.

(iii) it is easy to complain that the world is not as one would wish to find it. Nonetheless, we do find ourselves having to make decisions with long-term consequences in circumstances where even short-term funding is uncertain, where objectives and expectations are frequently changing and where those who we have traditionally funded to carry out research (the HEIs) are in a state of flux. Clarification of our remit and objectives will allow us to cope better with this situation, but will not solve it. More certainty in financial planning would make a major difference.

In March 1991 we reported the impact on you of the Science Budget allocation for 1991–92. How does this correspond with what actually happened? And do you think that the priority decisions which you were forced to make were, in retrospect, right?

The decisions corresponded closely with the impact expected in March 1991; those actually taken were:

— a reduction of 33 per cent in the value of new grants announced in 1991 compared to the previous year (at one stage it looked as if this reduction might have to be as much as 50 per cent);

— the Polar Cap Radar project was descoped (SERC contribution £1.8 million rather than £5 million previously planned); the Gravitational Wave Observatory and Lyman FUSE projects were removed from the SERC programme; and instruments for the Polar Platforms were initially affected significantly, but subsequently presented at a descoped level;

— under the Engineering Board selective cuts amounting to 20 per cent were made, particularly in information technology and ACME. Studentships were cut by 10 per cent on the previous year. Computing support at RAL was cut from £2.5 million to £0.75 million;

— reduced support for central computing facilities;

— the Nuclear Structure Facility was closed in March 1993;

— following a study of the UK's need for neutrons and negotiation with partners in ILL, the SERC's share in ILL was reduced from 33 per cent to about 25 per cent, resulting in a £4 million pa shift to grants.

The decisions took account both of the Council's priorities and its limited scope for making short-term cuts. Even in retrospect they were right.

What is the role of external assessors?

In our evidence on 24 March, we made it clear that assessors in no way dilute the peer review process. We see assessors as an important point of contact with other relevant organisations. How successful the contact is depends very much on whether the assessor is well briefed by, and provides good feedback to, his own organisation.

What is your input to the process whereby ABRC weighs your priorities against those of the other Research Councils? Do you have confidence in this process?

We discussed the role of, and problems facing the ABRC at some length during our hearing on 24 March. The HORCs are members of the ABRC and we have always had an opportunity to present our case. But SERC accounts for about half of the Science Budget and it is hard for the ABRC to compare a case prepared by SERC at the same level of detail as one prepared by, say, the much smaller ESRC. The ABRC generally also has to consider many more cases from SERC than for any other Research Council, so there is a tendency in any competitive process for SERC to lose out. As in all situations where advocacy is the essence of decision making, eloquence and presentation can win the day; and some cases are inherently easier to present than others. We continue to believe that the executive role of dividing the Science Budget cake should be separated from that of general scientific and technological advice.

The popular caricature of the research scientist would have us believe that he spends most of his current grant on work to support his next grant application—so that, in practice, research funding works largely in arrears. How true is that caricature to the working of your own grant-making process? And does it matter?

Like all caricatures, this is an oversimplified exaggeration. Presumably inherent in the question is the concern that, when money is tight, people are averse to taking risks. This concern has some validity. We believe it important that HEIs (and others) retain at least some unearmarked research funds to develop new ideas (including risky ones) and to allow young research workers to develop a track record. We also welcome a range of funding sources with different funding objectives.

Sir Mark Richmond, Chairman

10 *May* 1993

Further memorandum from the Science and Engineering Research Council

INTRODUCTION

The timing of the Select Committee's request for written evidence presents the SERC with a particular problem. As a result of the Government's recently produced White Paper ("Realising our Potential", Cm 2250), the SERC will cease to exist after 1 April 1994. We can comment on the mechanisms which have been used (and will continue to be used whilst SERC exists) to determine priorities, and on the more general issues of priorities for the science base, but it is difficult to comment on how the proposed new arrangements will affect the SERC's successor bodies (and, indeed, we would not wish to pre-empt the views of these bodies). In any event, the White Paper necessarily leaves much detail to be worked out and, until that detail is addressed, it will be difficult to know whether or not the proposed changes improve the setting of priorities. In what follows we, first, give some general reactions to the White Paper and then address the questions raised by the Select Committee, mainly with reference to the present situation but also indicating where the proposals in the White Paper could allay some of our concerns.

SERC'S REACTION TO THE WHITE PAPER

The Science and Engineering Research Council (SERC) is pleased that the White Paper has now been published after a year of debate on the vitally important issue of the Government's approach to Science and Technology. The Council notes with pleasure that the Government considers that the Research Council system has performed well in supporting high quality research. In particular, the Council takes pride in the Government's statement that it wishes to build on the steps already taken by the SERC to develop new approaches to its funding of research training. The SERC has pioneered many schemes for encouraging collaborative research with industry, such as Cooperative Awards in Science and Engineering (CASE) and the Teaching Company Scheme, and is now spending £70 million of its budget each year on such collaborations. The thrust of the White Paper on exploiting research to enhance industrial competitiveness—embraced in the missions given to Research Councils in the White Paper—builds on this strong base already established by the SERC.

In its submission to the Office of Science and Technology during the consultation process, the SERC advocated that clearer missions be set for the Research Councils and welcomes the way this is reflected in the Government's proposals.

The SERC is disappointed, however, that its proposals to form a coherent system by reshaping the Research Councils and the funding of research by Government Departments have not been followed by the Government. If changes are to be made to a system that performs well already, an opportunity has been missed by concentrating the changes on only part of the Research Council arrangements. The increase in the number of Councils from five to six also misses an opportunity to reduce the number of boundaries while still requiring the investment of resources in bringing about the changes.

The SERC is also disappointed that there is no positive indication in the White Paper that the new Councils will have increased resources to enable them to respond to the challenges of their new missions, especially in supporting applied research.

The SERC is nevertheless convinced that the missions given to the new Councils are positive and forward looking, and is committed to the achievement of a successful transition. The new Engineering and Physical Sciences Research Council will in very large measure continue the SERC's basic and strategic programmes in general science and engineering. The mission of this new Council corresponds closely to the SERC's current role, stated in its 1993 Corporate Plan, "to develop capabilities in strategic research related to industrial and social need". Nearly all of the SERC's current programmes aimed at fulfilling this role will continue under the new Council. This will include support of the SERC's Interdisciplinary Research Centres, the collaborative programmes with the DTI, the training of highly skilled people, and the new Innovative Manufacturing Initiative launched on 24 May. The SERC expects that universities, under the continuing Dual Support System, will have a central part to play in enabling the new Council to fulfil its mission.

The new Particle Physics and Astronomy Research Council will continue research and training programmes in these fields already supported by the SERC, as part of the SERC's current important role "to strengthen the UK's capabilities in fundamental research". The SERC welcomes, and gives strong support to, the commitment made in the White Paper to high quality, basic research as an essential ingredient of the Government's support of science and technology, and the recognition that much basic work in physics and astronomy requires commitment to international collaborations. This new Council will take over responsibility for the SERC's Observatories, now under single management.

Under the new arrangements it seems clear that SERC's Rutherford Appleton and Daresbury Laboratories will be undertaking work for several of the new Councils. Final decisions for the management of these two establishments will be taken by Government following input from a study, announced in the White Paper, of the detailed allocation of areas of science and technology between the new Councils. SERC regards it as imperative for effective operation that these two establishments remain under single management while undertaking work for several funding agencies.

QUESTIONS RAISED BY THE SUB-COMMITTEE

"What is public expenditure on the Science Base for?"

In our submission to the Government's review (prior to the publication of the White Paper) we identified five major reasons for the Government to support science and technology:

to underpin industrial competitiveness;

to underpin national security;

to secure as far as possible energy and resource independence;

to enhance the quality of life of individuals and society as a whole;

to maintain the intellectual knowledge base of the UK, thus contributing to national cultural heritage and world standing of the UK.

The SERC has explicitly stated its dual role of strengthening the UK's capabilities in fundamental research and of developing capabilities in strategic research related to industrial and social need. Implicit in both these tasks is the training of skilled manpower and the transfer of technology (often through the movement of trained manpower) necessary to ensure the exploitation of research ideas. There is inevitably a tension between the quest for understanding natural phenomena, which is the hallmark of a developed and civilised society, and development of the tools for wealth creation. The proposals in the White Paper should result in some reduction in this tension since the new bodies have more clearly defined objectives, with "wealth creation" being the over-riding purpose of most of them. It remains to be seen whether the new bodies experience difficulties in determining the right balance of basic, strategic and applied research.

"What are the objectives and priorities of the various funding agencies within Government, Research Councils, HEFCs, other departments? Are they related? Is an overview required and do the existing structures (ABRC, ACOST, OST) provide it?"

The changes introduced following the Rothschild report in the early 1970s quite clearly recognised that, for applied research at least, each Government Department should support the research it needs to do its job. This principle of "compartmentalisation" was, implicitly at least, applied also to other parts of the system. This has the merit that no single body can claim a monopoly on wisdom. Multiple funding sources may well have benefited UK science and technology. But as resources have become more limited and the costs and scale of the scientific endeavour increased, inadequacies have become apparent. A patchwork of organisations (such as ACOST) has been introduced to provide a greater overview and SERC has, for example, joined with other funding bodies (principally DTI) in increasingly complex arrangements to fund programmes of common interest. Many of these developments, however, have been a rather muddled response to immediate problems and the time is now right to develop clearer structures capable of ensuring more co-ordinated use of limited resources. It remains to be seen whether the proposals in the White Paper for a new Council for Science and Technology, clearer Departmental mission statements, a "Forward Look", technology foresight and new arrangements for linking the Research Councils into these processes will work smoothly but the intention of ensuring greater co-ordination, focus and openness is to be welcomed.

"What are the relationships connecting Government funding of the Science Base, funding by industry and charities, and overseas funding (particularly from the EEC)? Various people are 'paying the piper'; are they calling different or incompatible tunes, and if so, is this a bad thing?"

We believe a multiplicity of funding sources is, generally speaking, a good thing. During the 1980s, the main sources of increased funding to HEIs were the charities, industry and, in some cases, the EC. SERC, given the broad base of its funding responsibilities, monitors these developments and together with the UFC (and its successors), provides much of the "base" support on which the developments can occur. But careful monitoring of the consequences is necessary. For example, the growth in short-term contract work in HEIs has led to a substantial growth in the number of talented and often quite senior staff living "hand to mouth" from one short-term contract to another (a concern which is addressed in the White Paper). Similarly, given the restricted remits of some of the funding bodies, there is a risk of a lack of overall balance in the research supported (eg, most charities operate in the medical/biomedical field). SERC has done much to develop relationships with other funding bodies such as DTI and industry itself, other Government Departments and other Research Councils but these can be complex and difficult to administer efficiently. There are particular problems with regard to the funding of science and technology by the European Commission. EC policies appear to be focused more on the development of weaker EC member states than on key areas of science and technology where transnational co-operation between advanced member states would confer significant benefits to the community as a whole. In general, the assessment of quality is subordinated to community policy. In these circumstances, we believe that application of the EuroPES system is an unfair burden on the domestic Science Budget.

"What information and advice is needed by those who are setting priorities? How do they know what is going on in current low-priority fields? How do they track developments overseas?"

Priorities are mainly determined by four (not altogether independent) factors: political, financial, scientific and industrial. The White Paper has provided a needed new political steer and the new bodies set up as a result of it should be much clearer about their objectives. Sadly, the White Paper does not indicate increased financial resources; nor does it indicate whether the financial allocations to the new organisations will imply any revised priorities. It is particularly important for Research Councils that financial allocations are sufficiently stable and long-term to allow adequate planning; despite some recent improvements, more needs to be done. In the past, organisations like SERC have relied very much on the expertise of the members of its peer review system to advise on scientific and industrial priorities. We have no reason to believe that expertise in the UK has become weakened to the extent that there are significant areas of ignorance about (currently) low-priority fields or developments overseas. Most SERC Committees have at least one industrial member and, in the more applied areas, industrial members are sometimes in the majority. The White Paper plans to increase substantially reliance on "technology forecasting" to determine scientific/industrial priorities. Clearly these techniques have worked well elsewhere (particularly Japan), and if not used prescriptively, could add significantly to the information base which informs priority setting.

"How do charities and companies which fund research set and implement priorities? How is it done overseas? Are there lessons here for the Government?"

This is really for others to answer. It is worth pointing out, however, that it is easier to set priorities for achieving a goal when that goal is clear and straightforward (eg making a profit or finding a cause of/treatment for a disease). With the possible exception of Japan, and perhaps some European countries with a more dirigiste tradition, there is no reason to believe that other countries do a much better job of setting and implementing priorities at a national level. It is, however, noteworthy that Germany and the USA are making renewed efforts to improve the identification of wealth-creating generic technologies.

"What are the objectives and priorities of the HEFCs in funding university research through block grants, and who is setting them and on what basis?"

This is really for the HEFCs, their "customers" and "paymasters" to answer. Recently we have established good working relationships with the UFC and most of its successor bodies. The transfer of funds from the block grant to the Research Councils has gone reasonably smoothly although, inevitably, the consequences of the change will take some time to work themselves through. We do not advocate any further transfer of funds, believing that some block grant funding of research is essential to allow development of new ideas and to allow new researchers to establish a track record. We believe the recent UFC research assessment exercise (which formed, and will continue to form, the basis for allocating block grants) was well conducted and we note that most members of the assessment panels involved had good knowledge of the Research Councils, their priorities and policies.

"How is each university's block grant distributed between departments and on what basis?"

This is for the universities to answer; almost certainly the process differs from institution to institution. It is worth adding that our most recent Corporate Plan indicated that we would investigate the scope for allocating some of our funds on a "block" basis to certain HEIs (almost certainly those to which we have, in the past, made substantial grants on the basis of the quality of their work). Implicit in any such scheme is an expectation that universities would have sensible and robust procedures for allocating the funds to their best researchers. There would be rigorous evaluation of the outcomes of research supported in this way.

"What are the impacts on priority setting of:

(a) the abolition of the binary divide

(b) the regionalisation of funding

(c) the shift of emphasis from core funding to project funding involved in the transfer of £150 million pa from the HEFCs to the Research Councils

(d) formula-funding, research rating and moves towards an R-T-X model?"

(a) The effects of this change are still working themselves through. SERC has, in the past, supported work in polytechnics, where there were research strengths. Now these institutions are funded on the same basis as other universities it should be easier for them to find the underpinning resources to develop the strengths on which we can build. Nevertheless, the SERC must beware of spreading its limited resources too thinly amongst a greater number of universities.

(b) Again, the consequences are not yet clear, although there are signs that the HEFCs are developing different regional models. We believe that, to be effective, the Research Councils should operate throughout the UK. It is important that research funding should draw on a wide range of expertise and be made to those best able to undertake good research, wherever they are situated. If expertise is too narrowly drawn, the risk of patchy coverage of international scientific developments is real. We hope the HEFCs will be able to develop the HEIs in their areas so that they are well-placed to receive Research Council support, but we are concerned that different regional policies could hinder this.

(c) At the time of the transfer, the SERC was required to maintain the level of research grants to HEIs above a level which was consistent with earlier HEI funding levels. That we have done.

(d) It is probably inevitable that the Funding Councils will be obliged to use formulas to translate ratings from the research assessment exercise into funding allocations. Given the wide range of institutions now funded by the HEFCs (and the Research Councils, industry and others), it is inevitable that some will develop even greater emphasis on research and others be more teaching-based. We have recognised this in our proposals for possible block-funding of research activities in some institutions. The trend is likely to continue.

"The Research Councils have explicit missions. How are these translated into priorities, by whom and on what basis?"

The SERC's responsibilities are not as explicit as the question implies. Its Charter refers to research and training in "science and technology". The Council's own mission statement identifies the dual role of strengthening the UK's capabilities in fundamental research and of developing capabilities in strategic research related to industrial and social needs. There has been an understanding that the SERC acts as "residual legatee" in the sense that it is bound to consider any area of science and technology which the other Councils do not believe is part of their more narrowly defined remits. These broad, and sometimes conflicting, responsibilities have made priority determination particularly difficult. The more precisely defined missions of the new bodies set out in the White Paper should alleviate some of these problems. Each year SERC embarks on a major Forward Look exercise whereby the Council sets the overall financial guidelines within which each Board (and Committee) must plan its programme including, increasingly, justifying all the elements of the on-going core programme. The process is thorough and enables the SERC to put together its Forward Look proposals to the ABRC. Inevitably, change as a result of this process is slow but is nonetheless real. For example, there have been major shifts from nuclear and particle physics to engineering and technology and from expenditure in the Council's own Establishments to expenditure in HEIs. Presumably the new bodies will undertake somewhat similar exercises but informed by the technology forecasting exercises and the planned new "Forward Look" (somewhat different to the "business plan" implied by SERC's use of the term) to be prepared by OST. Resolution of the tensions encountered by SERC will presumably transfer to the Director-General of Research Councils and OST.

"How are the competing priorities of the different Research Councils (and the Royal Society and the Royal Academy of Engineering) reconciled within the limits of the Science Budget?"

The ABRC undoubtedly has an extremely difficult task in advising on the distribution of the Science Budget on the basis of the Forward Look presentations from the Councils and other bodies. Increasingly, the ABRC has been trying to assess core programmes as well as bids at the margins, but the activities of the major Councils have now become so diverse and complex that independent members of the Board, with limited time available for detailed analysis, must find assessing competing claims nearly impossible. It remains to be seen whether the new arrangements, with the functions of the ABRC being absorbed within the OST, will allow for better reconciliation of competing priorities. Certainly the existence of a clearer national strategy should provide a better framework for decision-making.

"Are the priorities of the different Research Councils skewed by the boundaries between the Councils' remits, by the existence of Research Council institutes, by international obligations to support 'big science' or by anything else?"

We have already commented on the problems which the SERC's "residual legatee" status (itself resulting from the more precise remits of the other Councils) causes us. This should be resolved in the new structure. The SERC has done much to reduce the inflexibilities caused by substantial commitments toward its own "institutes" (eg, closure of the Atlas Laboratory and the Appleton Laboratory; moving the Royal Greenwich Observatory and bringing the Observatories under a single management structure). It is important that a satisfactory solution is found to the reporting structure for the Daresbury Laboratory and the Rutherford Appleton Laboratory in the new structure. It is well known that the SERC's membership of international organisations for "big science" has caused problems of financial balance and has, from time to time, distorted priorities in the short term. It is easily forgotten, however, that membership of these organisations is usually the only way the UK can maintain a presence in these areas of science. It is equally important that, if the scientific opportunities offered by membership are to be exploited, there must be substantial domestic expenditure in the fields concerned. It may be that some of these problems will be reduced in the new structure (or resolved at a different level), although it should be noted that the number of boundaries has been increased by 50 per cent. Finally, we should note that different projects have different natural timescales. We must not stop participating in excellent science simply because the 10-20 year commitments implied could reduce our flexibility.

"How is the money transferred from the UFC to the Research Councils being spent?"

We have already commented on this. It will clearly take some time before applicants and their institutions become entirely familiar with the new system and we must ensure our own Committees support successful projects at the correct level. The transferred funds are being spent in HEIs, as was intended, but it is no surprise if the distribution of resources is not identical to that which preceded it.

Letter from the Scottish Office

I refer to your letter of 19 February which called for written evidence on a list of questions which the Sub-Committee wished to address.

The position of the Scottish Office, like that of other Government Departments, in relation to the general matters concerning priorities for the science base is covered by the Government's recently published White Paper "Realising our Potential: A Strategy for Science, Engineering and Technology".

The Scottish Office commissions research to meet the priorities of the Department and to underpin policy requirements. Plans are set out in the document "Serving Scotland's Needs" (Cm 2241) and details of actual spend are given in the "Annual Review of Research and Development".

The other area of the science base for which the Scottish Office has responsibility is funding research carried out by Higher Education Institutions, which is achieved through the Scottish Higher Education Funding Council (SHEFC). The Sub-Committee has heard detailed evidence from Professor Sizer of SHEFC.

If there are any specific points concerning the Scottish Office role on which the Sub-Committee wishes evidence from the Scottish Office, we will be happy to provide that information.

E B Miller

2 *July* 1993

Memorandum from Dr J B Searle, Department of Biology, University of York

I wish to make one brief point in my submission. I believe that the allocation of funds among scientists in Universities is not optimal at present. I am particularly concerned with the extremes in funding. Some "well-knowns" receive exceptionally large funds and others ("unknowns") have essentially no research money. There should be considerably more care than at present to monitor the performance of these two categories at both the research council and departmental level. I believe that money is often wasted because:

(1) "well-knowns" are allocated extra personnel when they have not the time to supervise them properly themselves nor the tier of senior postdocs to whom they can devolve that supervision

(2) "well-knowns" are given grants in subjects for which they have essentially no expertise and to which, in fact, they are likely to contribute little

(3) although a number of "unknowns" have the ability to supervise one or a few projects really well, making a thoroughly worthwhile contribution to their field, they are deprived of this opportunity because of lack of research council funds.

I submit that, to make the most of University scientists, every effort must be made to avoid such conspicuous instances of over- and under-funding.

Memorandum from Sharp Laboratories of Europe Ltd, Oxford Science Park

Background

Sharp Corporation is an international electronics company committed to the research, development and manufacture of innovative products. Founded more than 80 years ago in Japan, Sharp products are now manufactured in more than 25 countries around the world.

Sharp set up its first sales subsidiary in Europe in 1968 and its first European production plant in 1985. There are now sales subsidiaries in most of the European countries and four manufacturing and development facilities, one in France and Spain and two in the United Kingdom, both based at Wrexham in North Wales.

Sharp Research and Development in the UK

To complement these overseas sales and production activities Sharp established a research and development centre in the UK in 1990. Sharp Laboratories of Europe are now established on the Oxford Science Park, with 45 staff engaged on basic research into opto-electronics, artificial intelligence and liquid crystals. The second phase will expand the number of employees to 100 within a few years.

The aim of the Oxford Laboratories is to establish a role at the centre of Sharp's innovation activities within Europe and to generate creative ideas and undertake state of the art research in fields which are important to Sharp Corporation worldwide.

Sharp and the UK Science Base

Sharp Laboratories of Europe contribute in many ways to the UK Science Base. Research is funded in centres in two universities, including Oxford and is planned for others. Also, facilities within the Laboratories are provided to help with the training of students, particularly MSc students. We are supporting six CASE students in UK universities.

The UK was chosen by Sharp for its European Research location because of the outstanding international reputation of basic scientific research in the UK. Sharp hopes to be able to recruit high quality researchers with relevant expertise in the areas of interest to the Laboratories. Sharp also anticipates the fruitful exchange of knowledge and expertise with the centres of academic excellence in the UK.

As the Oxford Laboratories become more integrated into development and design with the European manufacturing centres, there will be an increased demand for highly qualified scientists and engineers with first rate training from centres of excellence in UK universities. Any weakening of the UK science base will be serious and potentially detrimental to the long-term investment by Sharp in the UK.

Priorities for the United Kingdom

We believe that the objectives and priorities of the science base should be the funding of research which is at the highest possible level in world competition. As an industrial company we do not expect a simple and exact correlation between our needs and university research. However, we look for an area of expertise which has developed to an advanced level to see if we can identify a new direction or application for the research which does match our needs. The university research base must not be fettered by over-dependence on contracts with industry.

As set out in the new White Paper, the existing structures for research policy, such as ACOST, OST etc, should have the important and essential role of setting priorities. It is their responsibilities for judging the needs of the UK for the next decade or more, and they should use all possible information sources and analyses to do this. Most of the major world economies have priority setting activities. The UK should access these where possible. Also, the UK needs a comprehensive industrial competitiveness analysis. Science Counsellors, the Royal Society etc can play an important role in providing information. Visits overseas funded by official organisations and charities should have as a condition the submission of a report on the visit to a policy body such as OST.

An important part can be contributed by inward investors in R & D from the US, the EC and Japan. Where these investments are complemented by manufacturing in the UK (and the EC), the priorities for the science base should reflect their preferences, as well as those of domestically-owned companies. The latter have worldwide diversification of activities and their research needs should not be the only consideration in setting priorities for the UK science base.

In summary, it is most important that the United Kingdom retains a strong science base, albeit after necessary priority setting, in order to remain an attractive location for international investors in research and development.

7 June 1993

Memorandum from Thorn EMI

1. *Public Expenditure on the Science Base is for*

- Training skilled personnel for industry, commerce, academe, government, charities, schools etc.
- Discovering, protecting and publishing new knowledge and new or improved applications of knowledge (technologies, materials, energy sources, minerals, treatments, policies, services, products, processes), sufficient in quality and quantity for some of it to be of value in contributing to wealth creation in the UK.
- Enhancing future options for mankind and the UK in particular.
- Improving our understanding of nature and natural phenomena and our place in the scheme of things.
- Improving our understanding of man-made systems and the effects of changes to these.
- Anticipating or predicting future events based on past experience and present knowledge.
- Providing focal points for international collaborations.

It is *not* directly for:

- Creating wealth—province of industry and commerce.
- Creating health—province of industry and commerce and Health Service (including vets and dentists).
- Creating comfort, leisure entertainment, personal security—province of industry and art.
- Defence—province of industry and MOD (including agencies).

- Growing food—province of farming, fishing, industry.
- Producing energy, fuels or minerals—province of industry.

2. *The Objectives and Priorities of the various funding agencies may be seen as follows:*

a. The Research Councils

- Funding research proposals of the highest quality and against a set of priorities relevant to their missions.
- Balancing quality versus quantity within limits, amongst various areas rather than simply funding "interesting work".
- Providing an adequate source of highly trained personnel.
- Providing capital items and facilities to enable high quality research, relevant to their missions, to be carried out cost effectively.
- Encouraging, where possible and appropriate, the protection and exploitation of research achievements.
- Evaluating the outcomes of research projects they have funded and relating this to their funding of further new proposals.
- Highlighting areas of importance that are not of sufficient priority to be supported within their baseline expenditures and bidding for extra funding to support these.
- Identifying research areas of particular timeliness and relevance and supporting these as special initiatives.

b. The HEFCs

- Funding the resource, fabric and infrastructures in UK HEIs—in support of teaching and research.
- Assessing the quality of teaching and research in UK HEIs in order to provide a degree of selectivity in their funding mechanisms.
- Encouraging UK HEIs better to collaborate with industry, commerce, charities, government departments and other agencies and to provide research capabilities to these at full economic cost.

c. Other Departments

- To fund research in support of formulating policy and achieving their policy objectives.
- To fund research in support of their statutory responsibilities, regulatory roles and operational requirements.

The above are related (eg, the RCs rely on the HEFC funding of space and academic salaries, government departments make use of RC institutes as providers of research, MOD and SERC jointly fund research proposals which are of relevance to MOD etc). An overview is indeed required to set priorities on a broad basis, establish where the various lines among RCs and HEFCs and other departments are drawn, to identify duplication and omissions and to avoid nugatory expenditure. The key to this is the setting of priorities on a rational basis and with contributing to wealth creation in mind. This requires the Research Foresight exercise (envisaged in the White Paper on Science and Technology) and a strong management system to implement the outcomes and co-ordinate the contributions of the government departments, Funding Councils and Research Councils to this end. The key roles of the Chief Scientific Adviser and the new Director General of the Research Councils will depend for their success not only on the excellence and capabilities of the incumbents, but on the levels of real clout associated with these roles. In particular, the new DGRC must be directly accountable both for the activities and the expenditure of the Research Councils. He/she must be the "Accounting Officer" responsible to the Chancellor and to Parliament for this. The DGRC needs to have the power to carry out his/her responsibilities and *must* be responsible for his/her actions.

3. Both government and industry would like more of a pay-off from the research achievements of the Science Base (paid for by taxpayers) in enabling more successful and competitive companies to operate in the UK. Industry funds those projects and people it believes will return a direct benefit to them and not all such projects require research. Charities fund projects or people they believe will benefit their missions and help them achieve their objectives. Overseas funding serves to promote European or international collaborations among different sectors with a view to enhancing training, discovery or wealth creation in appropriate areas. The various different and sometimes incompatible tunes they call can actually benefit the Science Base by enhancing and broadening the knowledge and experience of its constituents beyond purely academic concerns and in allowing researchers to identify new, high quality research areas deriving from a wider range of real problems of practical value.

4. Those who set priorities need to have some knowledge of those areas of international scientific and industrial activity where investment now is most likely to pay off in the definable future and those areas in which seemingly promising activities have stagnated or become inappropriate. This involves some imaginative insight into a wider range of future markets and their probable needs, considerable breadth and

depth of scientific expertise and, above all, time to deploy this knowledge in the context of analysing and reviewing science base activities and priorities. This must involve a wide range of high quality people who, among them, cover these requirements and are employed at competitive commercial rates for such people, to spend sufficient of their time in this way. In addition to these costs of employment, it must be realised that there will also be an opportunity cost (to them, their main employer and to the country) in removing them from the productive things they would otherwise be doing. Such real and opportunity costs mean that they should be used effectively and their collective views taken seriously and acted upon in all but the most exceptional circumstances. They should be carefully chosen and appointed for fixed periods (say three to five years) which are long enough for them really to get to grips with the various appropriate issues, but short enough to avoid a feeling of tenure or to cause stagnation. They should each be encouraged and funded to travel abroad in order to broaden and update their knowledge the better to inform their decisions and advice.

Unless the new Council for Science and Technology and the new DGRC are able to get industrial inputs and advice from sufficient of those at the highest levels in industry (worldwide), the new processes and mechanisms creatively envisaged by the White Paper on Science and Technology may turn out to be a waste of time and money. They must therefore really be implemented in the most professional way possible.

5. Companies set and implement priorities in all sorts of different ways according to the different exigencies and opportunities resulting from their different markets and missions. The pharmaceutical industry funds long term R&D both intramurally and extramurally and takes basic understanding through to protected products with a long life and a high return. The oil industry is mainly interested in proven technology which it can deploy operationally, but has recently experienced price pressures to reduce costs through developing some new technologies. The consumer electronics industry is mainly driven by manufacturing fashionable products at appropriate levels of quality and cost and with short design lifetimes reflecting their fashionable nature and the rapid advances in the electronics technologies which underpin them. Whilst the UK may continue its excellence in the first of these, our continued excellence in the second is open to question and our future excellence in the third depends upon inward investment reversing the disasters of the 1970s and 1980s. Returns on investment in R&D are now compared with the high returns available on a short timescale from other capital or operational investments. They need, therefore, to be efficient and of low risk. A strong, relevant Science Base will help to reduce the risks of investing in the exploitation of new discoveries and will be a major springboard for industrial sustainability and growth.

Dr K W Gray, Technical Director and *Prof I A Shanks*, Chief Scientist

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Memorandum from the Department of Trade and Industry

What is the Department of Trade and Industry putting into the science base (ie Universities and Research Council Institutes)? What is it getting in return?

1. DTI spends about £15 million per annum directly on R&D activities at Research Councils or Higher Education Institutes (HEIs) where the science base partner is in the lead. Further DTI financial support is given to R&D projects involving science base partners where they collaborate with others eg industry. Such support is given, for example, under the LINK scheme, where DTI spent nearly £16 million in 1992–93, on R&D projects involving the science base and industry.

2. DTI also has a substantial involvement with the science base through a number of other shared activities eg the Teaching Company Scheme and the Support for Technology Audits and Industrial Units schemes. The Department will also be funding academic and business exchanges under the Senior Academics in Industry Scheme (SAIS), the general objectives of which include enhancing the relevance of academic research and training to business needs. DTI and SERC have also been collaborating on the Post-Graduate Training Partnerships Scheme, a pilot scheme, embracing the Faraday principles, in which there is a close partnership between academia and industry to promote industrially relevant post-graduate training.

3. DTI works with the Research Councils to promote improved industrial relevance of training and greater interest in wealth creation—both major themes of the Government's White Paper on Science, Engineering and Technology. The development of partnerships between HEIs and industry encourages technology transfer and greater mutual understanding. Partnerships between DTI and the Research Councils are further encouraged by cross-representation on each other's advisory committees. Membership of some such Committees is shown in Tables 1 and 2.

4. DTI also interacts with the Research Councils through commissioned work to inform DTI policy. As a result, academic skills are brought to bear on industrial problems; scarce resources are multiplied (eg 4:1 in LINK); and there is a reduction in duplication which produces better value for money.

Table 1

DTI REPRESENTATION ON RESEARCH COUNCIL COMMITTEES

As at June 1993, DTI were represented on Research Council Committees, as below:

Science & Engineering Research Council	—on	43	Committees
Natural Environment Research Council	—on	7	,,
Agricultural & Food Research Council	—on	1	,,
Economic & Social Research Council	—on	1	,,
Medical Research Council	—on	none	

Note: These figures do not include representation on LINK Programme Management Committees, some of which are led by Research Council nominees.

Table 2

RESEARCH COUNCIL AND ACADEMIC (HIGHER EDUCATION INSTITUTES) REPRESENTATION ON DTI ADVISORY COMMITTEES

	Number of Members			
SPECIFIC TECHNOLOGY COMMITTEE	Total	HEIs	RCs	% of HEI & RC to Total
Advisory Council for Research and Development (ACORD)	16	1	2	19%
Aviation Committee	13	2	0	15%
Biotechnology Joint Advisory Board (BJAB)	15	7	0	47%
Coal Task Force Advisory Committee	14	2	0	14%
Environmental Technology Advisory Group (ETAG)	12	1	0	8%
Information Technology Advisory Board (ITAB)	15	7	1	53%
Space Technology Advisory Board (STAB)	19	3	2	26%
Standards, Quality & Measurement Advisory Committee (SQMAC)	20	5	5	50%

Note: Table covers some of DTI's main committees in specific technology areas.

What is your relationship with the Higher Education Funding Council (HEFC) (England)?

1. DTI has had regular interaction with the HEFC (England), which has been formally in existence only since 1 April 1993, and with its predecessor bodies.

2. DTI participated in the last Universities Funding Council/Polytechnics and Colleges Funding Council Research Selectivity Exercise by providing technical assessors to four subject panels (chemistry, physics, computer science and engineering) and four of the engineering sub-panels. Participation increased DTI's understanding of the selectivity process, enabled DTI to make a technical contribution, and helped DTI to make informed comments on the methodology.

3. The White Paper on Science, Engineering and Technology envisages the Research Councils and the HEFCs working together to implement proposals to make training more industrially relevant. DTI expects to make an input to this process.

Professor Graeme Davies (Chief Executive, HEFC(E)) told us on 28 April:

> *"The ability of the Welsh and Scottish Offices to fund near market research is not reflected through the equivalent English Office . . . it is unlikely there will be a regional funding policy for England that will mirror the regional funding policies in Wales and Scotland. This will be to the disadvantage of the English universities."*

Is this fair comment?

1. The Government's regional policy is designed to help redress regional imbalances in the economy, with particular emphasis on encouraging the development of local potential within the assisted areas with the long term aim of promoting self-generating growth.

2. The Scottish and Welsh Offices have responsibility for implementing policy in their regions; they take decisions on the balance, character and delivery of their R&D support eg, through the use of the Scottish Development Agency. There is no single English Department with equivalent responsibilities.

Sir Mark Richmond told us on 24 March that he envisaged making SERC funds available to industrial researchers, at the expense of research in universities. Would you support this?

1. DTI supports the Government's proposals in which individuals and organisations outside the present definition of the science and engineering base may in the future receive some Research Council funding in support of high quality research which accords with the Research Councils' missions.

What is your involvement with the research programmes of particular industrial companies or groups? Will the new "partnership" announced in the Science White Paper change it?

1. DTI continues to support research in specific technology areas which serve policy requirements or have wider economic benefits. These include areas such as space, aeronautics, measurement standards, nuclear and non-nuclear energy.

2. The new partnership announced in the White Paper will enhance our ongoing dialogue with industry and the science base across the whole climate for innovation, and will not be limited to specific industrial groups. One benefit from this, is that it will allow greater opportunity for firms to talk to DTI about their research programmes, if they wish.

3. DTI's Innovation Unit has a very broad remit to improve the awareness and application of the innovation process in the UK. This is not just limited to UK firms' approach to research and development. It embraces areas such as the management of change and better industry/university and industry/city dialogue. The Unit's activity is focused on shifting the UK culture towards a climate of greater innovation and long term sustained commitment to innovation, which the Department continues to vigorously support.

In the light of the White Paper, what do you expect your relationship to be with the OST and the Chief Scientific Adviser?

1. Throughout the period leading up to the White Paper, the President of the Board of Trade had a number of discussions with the Chancellor of the Duchy of Lancaster on the strategic direction and content of the White Paper.

2. DTI's Chief Adviser on Science and Technology and other DTI officials also worked closely with the Chief Scientific Adviser at OST, during the White Paper discussions and will continue to work with him on implementing the White Paper measures.

3. DTI is playing a major role in taking forward the commitments made in the White Paper, having particular interest in ensuring that future Government S&T policies are more effectively geared to increasing industrial wealth creation. DTI is working closely with OST on a number of areas, such as the Technology Foresight Programme and the Annual Forward Look.

July 1993

Letter from Dr J M Lackie, Director, Yamanouchi Research Institute

I understand that you have asked for comments on "Priorities for the Science Base", and would like to submit the following.

SUMMARY:

As Director of a Research Institute funded by a major Japanese Pharmaceutical company I consider that we want Universities to:

Carry out speculative and exploratory research that will identify starting points for our own goal oriented research.

Produce well-trained scientific graduate and research scientists who can be recruited for our research laboratories.

We do not want Universities to become "Contract Research Houses", because that detracts from their proper function as speculative and open research centres, nor do we want those valuable researchers who have the ability to train a new generation of scientists to be distracted by the need to become entrepreneurs in order to maintain their research groups.

BACKGROUND:

Yamanouchi Pharmaceutical Company is one of Japan's larger pharmaceutical companies, specialises in ethical pharmaceuticals, and is one of the top 30 world pharmaceutical companies. Within the company there are more than 1,000 research staff and the company considers itself to be research led—as do all the major pharmaceutical companies.

The Yamanouchi Research Institute in Oxford was set up in 1990 by Yamanouchi Pharmaceutical Co. as part of their internationalisation plan. That they chose to locate their first overseas research laboratory in the UK was a vote of confidence in Britain's innovative research environment, particularly our strength in pharmaceutical discovery. Not only are we conducting active research within the Institute, in the hope of finding new targets for drugs, but we are encouraged to develop collaborative links with academic research workers, even though most of the results of this collaborative work will become public domain knowledge. We have an active programme of funding collaborations with academia, including research Fellowships in Oxford and research studentships in several Universities.

WHAT WE WANT FROM THE SCIENCE BASE:

We would like to make explicitly clear what we look for in the "Science Base"; in a sense this is a direct response to the question " . . . are they calling different or incompatible tunes . . . ".

1. *Exploratory research:*

We see the role of Universities as being places where speculative and exploratory research is conducted. Since major breakthroughs are by definition unpredictable it is essential that a broad range of research is supported, even if it appears unconventional or contrary to current dogma.

Though it is impossible to legislate for discovery, innovation can easily be inhibited. The only certainty is that new opportunities will not be identified unless basic research is supported. The commitment to research has to be long-term; this is well understood within the pharmaceutical industry and short-term strategies are unlikely to foster truly innovative research.

Once the relevance of new discoveries to drug discovery and development become clear then we can and should do such research ourselves. We cannot, however, cover the full range of exploration within our research units and we rely upon a broad spectrum of good speculative research within the University sector.

Training research scientists:

One of the Universities' main products is trained graduates and postdoctoral level research scientists. An essential part of the training that we expect them to have received requires exposure to a strong research-oriented environment where they will have learnt the skills that are needed to conduct biomedical research. If honours level teaching is not by academics with a personal involvement in research then it is unlikely to inspire the enthusiasm and interest in basic science that we take for granted. For research students it is even more critical that the environment in which they receive their training is one in which first-class research is conducted and modern equipment and techniques are commonplace.

In setting up the Institute we recruited most of our research staff from academia. Our major need was for scientists who had already received their training in research and who could conduct independent projects at a high level. Much of our recruitment is at post-doctoral level, though we also take on graduate research assistants, and we expect to continue to recruit people on a regular basis. We do not expect to have to train our newly recruited staff in basic research techniques, though we have to teach them to focus their efforts more directly upon projects which have a clear target. Our own research is more goal-oriented and less speculative than we would expect to find in a University Department.

What we don't want:

Academic departments becoming contract houses:

We do not want academic laboratories to conduct contract research. Specialist contract research houses exist for this purpose—and themselves provide jobs for many science graduates. Though we do enter into contract agreements, we consider that such contracts are detrimental to the main purpose of the academic departments, and research contracts compromise the exploratory research capability of the academic department. Contracts have defined goals, and the outcome of the work is predictable—an answer to a very specific question, sometimes of little intellectual interest. This is not the sort of work that University departments should be doing and it will detract from their primary purpose. It is an inappropriate way for them to obtain funds for their main research and research-training functions.

Increasingly Departments have confidential "commercial" projects in progress and we are finding that this hinders the open scientific discussion that we expect to be able to have with academic experts. Not only is it obviously an embarassment to the academic scientists involved, but it introduces a serious constraint in the flow of discussion. Unconstrained discussion is often the way in which new ideas arise and it is through the sharing of basic research findings that progress is often made. Although we understand the need to protect intellectual property rights, the growth of ideas can be stunted in an intellectually impoverished environment.

We believe that the training of first-rate scientists involves teaching by academics who are actively engaged in, and enthusiastic about, research. If their research is confidential then it loses much of its potential value within a training environment. It is unsatisfactory if there are areas of work that cannot be freely discussed—and such work does not give rise to projects for research students or undergraduates.

Research scientists trying to be entrepreneurs:

Good research scientists are a valuable resource both nationally and internationally. Some research scientists, though not all, also have the ability to communicate their enthusiasm and skills to young scientists. Since a good research scientist with teaching skills can influence many young scientists they are an especially valuable resource—even if their personal research is somewhat esoteric. Such research-teachers should not waste their time on trivial things such as routine administration and service teaching, nor should they be forced to add the additional skills of entrepreneurship if they are to manage to support their research groups.

This is not to denigrate the importance of entrepreneurs, and of scientific entrepreneurs in particular, but business skills should not be expected of academic scientists.

I hope these comments are of some interest—and that I am one of many making similar remarks.

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